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福建省研究院動植物研究所

研究彙報

第一號

RESEARCH BULLETIN

No I

THE INSTITUTE OF ZOOLOGY AND BOTANY
FUKIEN ACADEMY

民國三十四年十二月
福建省研究院印行
福建　安

Published by
THE FUKIEN ACADEMY
YUNGAN, FUKIEN, CHINA
December, 1945

中科院植物所图书馆
S0053299

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福建產黑粉菌科數種眞菌之研究

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NOTES ON SOME FUKIEN SPECIES OF THE FAMILY USTILAGINACEAE

by LING Yong and CHEN Tsing-Lien

中國產黑粉菌科（Ustilaginaceae）之見諸記載者，約有五十種。此約數係依據戴方瀾氏中國眞菌名稱及若干晚近發表之論著估計而得者。惟在福建，則此類眞菌之搜集絕少。除若干栽培植物之習見病菌不計外，其他寄生於自生植物者，僅知有Ustilago屬之四種（U. Cynodontis P. Henn., U. Robenhorstiana Spreng., U. Tonglinensis Tracy et Earle, U. sphaerogena Burr.）而已。

一九四二年秋季，吾人曾於福建中部之旅行中從事眞菌之搜集。此項研究之一部份結果，即載於此文中，此後在他處採得之數種，又復加入。計共記載三十餘種，分隸於中國已知七屬中之六屬。

此三十餘種中，有四新種及一新變種，又有十三種在中國尚爲初次發現者。此等種之名稱列下：

Ustilago spermophoroides新種，U. Cordai Liro, Sphacelotheca tonglinensis（Tracy et Earle）新名，S. sacchari新種，S. Polygoni-senticosi（P. Henn.）Miyabe et Takah., Farysia Caricis-felicinae S. Ito, C. olivacea(DC.) Syd., Cintractia axisola

(Berk.) Cornu, C. Suedae Sawada, C. Fimbristylis-Kagiensis Saw. var. fukienensi 新變種，C. pilulifera 新種，C. pulchra S. Ito, Sorosporium Arundinellae Syd., S. Paspali-Thunbergii (P. Henn.) S. Ito, S. formosanum Saw., S. flagellatum Syd. et Butl., S. Andropogonis-micranthi 新種，Tolyposporium bullatum (Schrot.) Schrott. 至於其他在中國已知之種，則名見下文中。

關於胞子形成之問題，在若干屬及種中，本文亦略予椃討。又 Ustilago Kusanoi Syd. 寄生於芒所致之特殊病態 (forma anomala ovariicola)，亦附及焉。

此初次之菌學試探，雖所得材料無多，然足證福建菌類之繁富，留待吾人從事之分類工作，正無限量也。

So far as our knowledge goes, there were recorded from China about fifty species of smut fungi belonging to the family Ustilaginaceae. This roughly estimated number is based on the list compiled by Prof. F. L. Tai, of Tsinghwa University, and on some other recently published papers, But unfortunately Fukien remains to this day comparatively little explored on this mycological branch. Apart from some common parasites confined to cultivated plants, only four species of *Ustilago*, really occurring on spontaneous plants of this region, were recognized, namely: *U. Cynodontis* P. Henn., *U. Robenhorstiana* Spreng., *U. tonglinensis* Tracy et Earle, and *U. sphaerogena* Burr.

In the autumn of 1942, we have the opportunity to make a fungal collection duriug our journey through the central Fukien and a part of our preliminary studies constitutes the main matter of this paper. Subseqneutly some species found elsewhere are also herein embodied, and eltogether more than thirty species, scattered among six oix of the seven Chinese known genera, are commented.

Of these, four species and one variety are described as new and about thirteen previously described ones are for the first time accredited to China. These are: *Ustilago spermophorides* sp. nov., *U. Cordai* Liro, *Sphacelotheca tonglinensis* (Tracy et Earle) comb. nov., *S. sacchari* sp. nov., *S. Polygoni-senticosi* (P. Henn.) Miy. et Takah., *Farysia Caricis-fillcinae* S. Ito, *F. olivacea* (DC.) Syd., *Cintractia axicola* (Berk.) Cornu, *C. Suedae* Sawada, *C. Fimbristylis-Kagiensis* Sawada var. *fukienensis* var. nov., *C. pilulifera* sp. nov., *C. pulchra* S. Ito, *Sorosporinm arundinellae* Syd., *S. Paspali-Thunbergii* (P. Henn.) S. Ito, *Sorosporium arundinellae* Syd., *S. Paspali-Thunbergii* (P. Henn.) S. Ito, *S. formosanum* Sawada, *S. flagellatum* Syd. et Butl., *S. Andropogonis-micranthi* sp. nov., and *Tolyposporium bulladum* (Schröt.) Schröt.

This first attempt of mycological exploration, reveals how rich and complex the

fuugal vegatation of this region is. and what a great amount of taxonomic work awaits the doing.

USTLIAGO (Pers.) Roussel

Fl. Calvados, ed. II, 44 (1806)

UATLIAGO HORDEI (Pers.) Lagerh., Mitteil. Bat. Bot. Vers., 70 (1889); Liro Utilag. Finn., I, 103 (1924) ; S. Ito, Myc. Fl. Jap., II, 8, fig. 2 (1936).

Uredo segetum α *Hordei* Pers., Disp. Meth. Fung., 57 (1797).

Ustilago segetum Ditm., in Sturm, Deut. Fl., III (1), 67 (1817).

Ustilago carbo-Hordei, Phillip., Traite Car. Charb., 92 (1887), p. p.

Ustilago carbo α *vulgaris* c. *Hordeana* Tul., in Ann. Sc. Nat., 3 ser, VII, 80 (1837), p. p.

Ustilago segetum var. *Hordei* f. *tecta* Jens., Om. Korns. Brand., 61 (1888).

Ustilago Jensenii Rostr., Overs. Kong. Densk Vid. Selsk. Forh., 12 (1890).

Ustilago Hordei (Pers.) Kell. et Swing., in Ann. Rep. Kans. Agr. Exp. Stat., II, 268 (1890) ; Teng, in Biol. Jab. Sc. Soc. China, VII, 100 (1932) ; Yen, in Contr Inst. Bot. Acad. Peip., II, 171 (1934) ; Shen, in Sinensia, IV, 303 (1934).

Habit : On *Hordeum sativum* Jens. Fukien : Sanyuan, Sinkow (三元莘口), Apr. 27, 1942 (Chen. 150).

The species occurs on Barley, causing the well known covered smut disease.

USTILAGO NUDA (Jens.) Rostr., in Tids. Landbk., VIII, 745 (1889) ; Liro, Ustil. Finn., I, 107 (1924) ; S. Ito, Myc. Fl. Jap., II, 12, fig. 6 (1936).

Ustilago segetum Ditm. in Sturm, Dent. Fl., III, (1), 67 (1897). p. p.

Ustilago carbo-Hordei Philipp., Traite Car. Charb., 92 (1837), p. p.

Ustilago carbo α *vulgaris* c. *Hordeana*, Tul., in Ann. Sc. Nat., 3 ser. VII, 80 (1847), p. p.

Ustilago segetum var. *Hordei* f. *nuda* Jens., Om. Korns. Brand., 62 (1888).

Ustilago nuda (Jens.) Kell. et Swing., in Ann. Rep. Kaus. Agr. Stat., II, 277 (1890) ; Teng, in Contr. Biol. Lab. Sci. Scc. China, VII, 100 (1932) ; Yen, in Contr. Inst. Bot. Acad. Peip., IV (1936) ; Shen, in Sinensia IV, 303 (1934).

Habit : On *Hordeum sativum* Jens. Fukien : Sanyuan, Sinkow (三元莘口), Apr. 27, 1942 (Chen. 153).

The species occurs on Barley, causing the well known loose smut disease.

USTILAGO TRITICI (Pers.) Rostr., Overs. Kong. Denske Vid. Selsk. Forh., 15 (1890); Clinton, N. Am. Fl., VII, 8 (1906); S. Ito, Myc. Fl. Jap., II, 13 fig. 7 (1936).

Uredo segetum β *Tritici*, Pers., Disp. Meth. Fung. 57 (1794).

Ustilago segetum Ditm., in Sturm. Deut. Fl. III, (1), 67 (1817).

Ustilago carbo-Tritici Phili, P., Traite Car. Charb., 92 (1837).

Ustilago carbo α *vulgaris* a *Tritica* Tul., in Ann. Sc. Nat., 3 ser. VII, 80 (1847).

Ustilago segetum var. *Tritici* Jens., Om. Korns. Brand., 61 (1888).

Ustilago Tritici (1890); Liro, Ust. Finn., I, 110 (1914); Teng, in Contr. Biol. Lab. Sc. Soc. China, VII, 100 (1932); Yen, in Contrib. Inst. Bot. Acad. Peip., II, 171 (1934); Shen, in Sinensia, IV, 308 (1934).

Habit: On *Triticum vulgare* L. Fukien: Shahsien, vicinity of city (沙縣城郊), Mar. 15, 1942 (Chen. 178).

The species causing the commom loose smut on wheat, is of great economic importance in this province.

USTILAGO SPERMOPHORA Berk. et Curt., Cat. Pl. N. Car., 123 (1867); Sacc., Syll. Fung., VII, 466 (1888); Clinton, in Proc. Bot. Nat. Hist. Soc., XXXI, 365 (1904), et N. Am. Fl., VII, 12 (1609); Shen, in Sinensia, IV, 310 (1934); S. Ito, Myc. Fl. Jap., II, 16 (1936).

Ustilago Kusanoana P. Henn., in Hedw., XIII, 140 (1904); Sacc., Syll. Fung., XVII, 477 (1905).

Sphacelotheca Kusanoana P. Henn., in Engl. Bot. Jahrb., XXXIV, 584 (1905);

Cintractia Kusanoana Shirai, List, I, 20 (1905).

Ustilago orientalis Yen, in Contr. Inst. Bot. Acad. Peip., II, 7, fig. 4 (1935).

Ustilago spermophora var. *orientalis* Yen, in Contr. Inst. Bot. Acad. Peip., IV (1936).

Sori in ovaries, concealed by the floral part, forming spherical, ovoid, and often oblique swollen body of 1–1.5 mm. in length and 0.7–1 mm. in width, protected for some time by a firm greenish colored host epidermis and some semigelatinized fungous threads; in time this becoming ruptured and disclosing the dusty black spore-mass. Only a few ovaries of the panicle being infected.

Spores subglobose, ellipsoidal. or occasionally somewhat irregular, usually 8–10 μ, or rarely 4–8 × 7–12 μ; epispore light brown, minutely echinulate.

Habit: On *Eragrostis ciliapensis* (All.) Link. Fukien: Shahsien, vicinity of the city (沙縣城郊), Oct. 24, 1942 (Chen. 304).

Ustilago spermophora var. *orientalis* Yen. said to be distinguished from the typical form by darker spores, was referred by T. L. Tai to this species.

It is noteworthy that chlorophyll grains remain intact in the epidermis of injured ovaries and give a characteristic color to the false membrane.

USTILAGO SPERMOPHOROIDES Ling et Chen, sp. nov.

Sori ovaricoli eaque in corpuscula ovoidea ellipsoidea fusiformi fere obliqua 0.8–1 mm. longa 0.3–0.5 mm. crassa transeuntes, primo epidermide ovarii firma viridula tecti, demum massis sporarum atris pulverulentis vel interdum omnino decidui. Sporae sphaeroideae, ovoideae, ellipsoideae, rarius irregulares, 8–14 μ vel 12–15 × 6–12 μ metientes, epispora plus minusve sature brunnea minute echinulata praeditae. Hab. in ovariis *Eragrostis japonicae* (Thunb.) Trin.

Sori in ovaries, surrounded by the floral parts, prominent, exceeding the glumaes, forming ovoid, ellipsoidal, fusiform swollen bodies of 0.8–1 mm. in length and 0.3–0.5 mm. in width, protected for some time by a firm greenish colored false membrane composed of host epidermis and some semigelatinized hyphae; this membrane turning to grayish, finally rupturing and allowing the escape of dusty black spore-mass; sometimes sori falling entirely. All or a few ovaries of a spiklet being infected.

Spores spheroidal, ellipsoidal or eventually irregular, 8–14 μ or 12–15 × 6–12 μ; epispore light to dark brown, finely echinulate.

Habit: On *Eragrostis japonica* (Thunb.) Trin. (*E. interrupta* Palis var. *tenuissima* Stapf.). Fukien: Shasien, vicinity of city (沙縣城郊), Oct. 10, 1942 (Chen. 301).

This species strongly resembles *U. spermophora* Berk. et Cart. in shape and color of fruiting bodies. It may, however, be distinquished by the larger and darker spores and by the sori exceeding the enveloping glumes. These two species are both remarkable among the genus *Ustilago* by their sori inclused in the rather firm host epidermis.

USTILAGO CYNODONTIS P. Henn., in Bref. Unters. Gesammt. Geb. Myk., XII, 105 (1895); Sacc., Syll. Fung., XIV, 416 (1899); Mcalp., Smut of Austr., 155 (1910); Schell., Beitr. Krypt. Schw., III, 13 (1911); Aeng, in Contr, Biol. Lab. Sc. Soc. China, VII, 93 (1932) Yen, in Contr. Inst. Bot. Acad. Peip., III, 52, fig. 8, pl. VIII, fig. 1–24 (1935); Shen, in Sinensia, IV, 302 (1934); S. Ito, Myc. Fl. Jap., II, 23. fig. 20 (1936).

Ustilago segetum var. *Cynodontis* P. Henn., in Engl. Bot. Jahrb. XIV, 369 (1892).

Sori in spike, entirely destroying the glumes and floral parts; spores globose,

ovoid, usually 6–9 µ, with light brown and smooth epispore.

Habit: On *Cynodon dactylon* Pers. Fukien: Yuntai, Taikow (永泰口), Sept. 10, 1942 (Chen. 191); Yungan, Moping (永安茅坪), Oct. 1, 1942 (Ling without no.).

USTILAGO ESCULENTA P. Henn., in Hedw., XXXIV 10 (1895); Sacc., Syll. Fung., XI, 232 (1895); Hori, in Ann. Myc., , 150, Pl. VI–VII (1907); Teng, in Contr. Biol. Lab. Sc. Soc. China, VII, 99 (1932); Yen, in Ann. Crypt. Exot., VII, 87, pl. XI–XII (1934), et in Contr. Inst. Bot. Acad. Peip., III, 8, pl. I–IV (1935); Shen, in Sinensia, IV, 211 (1934); S. Ito, Myc. Fl. Jap., II, 24 (1936).

Habit: On *Zizania latifolia* Turcz. Fukien: Yungan, Moping (永安茅坪), Oct. I, 1942 (Chen. 308).

The affected shoot of host plant is commonly cultivated for edible use.

USTILAGO KUSANOI Syd., in Mem. Herb. Boiss. N. 4 (1900); Sacc., Syll. Fung., XVI, 369 (1902); P. Henn., in Engl. Bot. Jahrb., XXXII, 35 (1903); Teng, in Contrib. Biol. Lab. Sc. Soc. China, VII, 100 (1932) Shen, in Sinensia, IV, 302 (1934): S. Ito, Myc. Fl. Jap., II, 20, fig. 16 (1936).

Sori usually involving at early time the whole inflorescence and the apical part of stem, converting them into a prominent slender whip-like body reaching often 50 cm. long and 3–4 mm. cross, protected at first by the leaf-sheath which becomes soon shredded, covered for some time by a leaden-colored delicate transparent false membrane chiefly composed of host tissues; upon the rupture, the dusty black spore mass becoming scattered and leaving behind the naked elongated axis of infected inflorescence.

Spores subglobose, ovoid, or angularly globose, 4–6 µ in diameter; epispore smooth, yellow brown; sterile cells usually catenated, hyaline, subglobose or subangular, usually 8–20 µ, intermixted with spores.

Habit: On *Miscanthus sinensis* Hack. Fukien: Yungan, Moping (永安茅坪), Sept. 25, 1942 (Chen. 288); Yuntai, Caiyang (永泰蓋洋), June 12, 1942 (Chen. 231). On *Miscanthus* sp. Fukien: Shahsien, vicinity of city (沙縣城郊), Oct. 15, 1942 (Chen. 299).

Although the material cited above is referable to the single species, there is considerable variation in the sorus formation. Sori may appear on very young host plant as well as on inflorescence. They are in the former case, however, much smaller and shorter. In addition to this, we refer also to this species the following specimen in which a quite different mode of infection may be observed.

Forma anomala ovariicola. —— Soris in ovariis evolutis, elongatis, filiformibus,

circinato-tortuosis, 3—5 cm. longis, 0.5—0.6 mm. crassis, primo glumis (paleis) fere immutatis hypertrophicis virescentibus persistentibus inclusis, dein prominentibus epidermide plumbeo-albescente transparente tenuissime tectis erumpentibusque; caetera ut in typo. Habit: in ovariis *Miscanthi sinensis* Hack.

Sori in ovaries, converting them into elongated filiform bodies, often circinate and tortuose at the upper part, 3—5 cm. long, 0.5—0.6 mm. broad protected at first by the virescent persistent and strongly deformed inner glumes, covered by thin transparent leaden colored host epidermis, then throwing out and becoming ruptured. Habit: On *Miscanthus sinensis* Hack. Fukien: Yuntai, Wutungwei (永泰梧桐尾), June 5, 1642 (Chen. 298).

The specimen consists of two inflorescence branches probably of the same host plant; nearly all spiklets are injured in one of these branches and but a few in the other. The deformation of injured spiklets is marked by an abnormal development of the flower parts. The inner glumes, which are small and thinly membraneceous in normal flowers, become much increased in size, thickened, acquiring a foliar texture. Of these glumes, the superior one (palea), especially, grows excessively elongated, wrinkled, often distorted in the upper portion, enfolding the filiform sorus. Usually, however, the outer glumes become slightly enlarged, but remain unchanged in form. Forced growth of the flower parts is remarkable so that Injured inflorescence gives rise to a sort of „witches' broom". A such sorus, arising from a single ovary and surrounded by the deformed glumes, is comparable to the usual whip-like sorus formed by whole inflorescence, though in different proportions.

Judging from the microscopic feature, the fungus seems to be conspecific with *U. Kuwanoi* Sydow. It is not difficult to conceive that when the mycelium grows through the host tissues in certain manner to keep pace with the growth of its host plant until blooming time, the fungus would find finally as seat of attack but the developing ovaries, where formation of spores must be restrained. This permit possibly to explicate why in the abnormal form sori are borne exclusively from ovaries.

USTILAGO SCITAMINEA Sydow, in Ann. Myc., XXII, 281 (1924); S. Ito, Myc. Fl. Jap., II, 25, fig. 22 (1936).

Ustilago Sacchari Fisch. d. Waldh., Les Ustil. esq. Monogr., 24 (1928), p. .: Sacc., I, 25, pl. IV (1906); Shen, in Sinensia, IV, 307 (1934), non Robb.

Sori in inflorescence, converting it into a very prominent elongated whip-like body up to 30 cm. long and 5—6 mm. cross, surrounded at first by the leaf-sheath, covered by a delicate leaden-colored false membrane composed of host tissues and some semigelatinized fungous threads, this rupturing and disclosing a dusty black brown spore mass which becomes scattered, and leaving finally behind the long naked axis of infl-

crescence.

Spores subglobose, ovoid, occasionally irregular, about 6—10 μ in diameter, epispore brown, minutely echinulate; sterile cells light brown tinted, associated in chains or in groups, subglobose or angular, thickly walled, much larger than spores.

Habit: On *Saccharum officinalum* L. Fukien: Sanyuan, Pantow (三元[illegible]), July 16, 1942 (Chen. 282).

The fungus causing the smut of Sugar-Cane, is of great economic inportance in this region.

USTILAGO COICIS Bref., Unters. Gesammtgeb. Myk., XII, 110, pl. VI, fig. 30—31 (1895); Sacc., Syll. Fung., XIV, 412 (1899); S. Ito, Myc. Fl. Jap. II, 34 (1936).

Habit: On *Coix Lacryma-Jobi* Linn. Fukien: Lungyen, Shihchung (龍岩[illegible]), Nov. 10, 1943 (Ling. 4990); Ninyang, Sitah ([illegible]), Dec. 25, 1943 (Ling, without no.).

The fungus causes smut of Job's-tears.

USTILAGO ZEAE (Beckm.) Ungar., Einfl. Bodens, 211 (1836); Clint., in Proc. Bot. Soc. Soc. Nat. Hist., XXXI, 362 (1904); Schell, Beitr. Krypt. Schw., III, 28, fig. 13 (1911); Linden. Krypt. [illegible] (3), 47, fig. 1 (1912); Yen, in Contr. Inst. Bot. Acad. Peip., III, 49, fig. 7, pl. VII, fig. 1—27 (1935); S. Ito, Myc. Fl. Jap., II, 36, fig. 35 (1936).

Lycoperdon Zeae Beckm., Hannov. Mag., VI, 1330 (1768).

Ustilago Maydis Corda, Icon. Fung., , 3 (1842); Fisch. d. waldh., Les Ustil. esq. Monogr., 41 (1877); Sacc., Syll. Fung., VII, 472 (1888); Plowr., Monogr. Ured. et Ustil., 273 (1889).

Ustilago Zeae-Mays Wit., Pilz. Deutch., I, 97 (1884); Bubak Pilz. Bohm., II, 18 (1916).

Ustilago Mays-Zeae Magn., in Deut. Bot. Monatsch., XIII, 50 (1895).

Habit: On *Zea Mays* Linn. Fukien: Yungan, (永安), Herbarium of Agricultural Experiment Station (without no.).

The fungus producing the smut galls on Maize.

USTILAGO SHIRAIANA P. Henn., in Engl. Bot. Jahrb., XXVIII, 260 (1901); XXXII, 35 (1903); Sacc., Syll. Fung., XVI, 369 (1902); Hori, in Bull. Imp. Agr. Exp. Stat Tokyo, I, 14 (1905); Pali. et Charl., in Phytopath., VI, 351 (1916); Sydow, in Ann. Myc., XII, 160 (1914); Shen, in Sinensia, IV, 306 (1934); S. Ito, Myc. Fl. Jap., II, 28 (1936).

Cintractia Bambusae Miyabe et Hori, Bot. Mag. Tokyo, XIX, 199 (1905); Sacc., Syll. Fung., XXI, 512 (1912).

Sori on young shoots destroying partially the branchlets, forming slightly swollen tubular bodies coated on the infected internodes, protected at first by the leaf-sheathes which become shredded in time setting free the dark reddish brown spore mass, leaving at last the decorticated dirty stem behind.

Spores subglobose, ellipsoidal, oblong, 6–10 μ in diameter, epispore smooth, brown tinted.

Hadit: On *Phyllostachys spp.* Fukien: Shahsien, Lankow (沙縣琅口), March 29, 1942 (Chen. 232); Yuntai, Gaiyang (永泰蓋洋), June 12, 1942 (Chen. 232).

The fungus is widely distributed in southern China, occurring on many species of *Phyllostachys, Sasa, Arundinella*, etc. The leaf-sheathes are left intact surrounding the sorus. The presence of fungus seems to excite the growth of infected shoots and cause the production of a sort of witches' broom with shortened branches and small leaves.

USTILAGO RETICUATA Liro, Ustil. Finn., I, 20 (1924); Yen, in Contr. Inst. Bot. Acad. Peip., IV, (1936); S. Ito, Myc. Fl. Jap., II, 42 (1936).

Ustilago utriculosum Ungar, Einfl. Bodens, 211 (1836), p. p.; Schell, Beitr. Krypt. Schw., III, 59, fig. 31 (1911), p. p.

Ustilago utriculosa Tul., in Ann. Sc. Nat., 3 sér. VII, 102, pl. IV, fig. 2–6 (1847), p. p.; Sacc., Syll. Fung., VII, 476 (1888), p. p.

Cocoma utriculosum Link. Sp. pl., VI (2), 9 (1825), p. p., non Nees.

Uredo utriculosa Corda, Ic. Fung., II, 2, pl. VIII, fig. 12 (1838), p. p. non Duby.

Sori in ovaries, surrounded by the floral envelope, forming slightly swollen globose bodies covered at first by the host epidermis which is green then turning to purplish; this soon rupturing and the purplish brown or dark brown spore mass becoming scattered.

Spores spheroidal, ellipsoidal, transparent, about 8–14 μ in diameter; epispore purplish brown with large prominent winged reticulations, areolae usually 5–6 gonal, 3–5 μ broad, wings very thin, transparent.

Habit: On *Polygonum opacum* Samuelsson. Fukian: Sanyuan, Shayang (三元沙洋), Apr 29, 1942 (Chen. 152). On *Polygonum viscosum* Ham. Fukien: Sanyuan, Shayang (三元沙洋), Apr. 29 1942 (Chen. 153).

The species is characterized by the medium-sized spores with rather large reticulations; it has been reported on *Polygonum lapathifolium* Ait., *P. nodosum* Pers., etc.

USTILAGO CORDAI Liro, Ustil. Finn., I, 12 (1924); S. Ito, Myc. Fl. Jap., II, 42, fig. 41 (1936).

Ustilago utriculosa Auct. plur. p. p.

Sori in ovaries, surrounded by the perianth segments, forming slightly swollen spherical bodies up to 2—3 mm. in diameter, covered by the greenish then purplish host epidermis; this soon rupturing and the purplish brown spore mass becoming scattered.

Spores spheroidal, ellipsoidal, eventually irregular, transparent, about 8—12 μ in diameter, epispore purplish brown, with rather small prominent winged reticulations, areolae usually 5–6-gonal, 2—3 μ broad, wings very thin, transparent.

Habit: On *Polygonum hydropiper* L. var. *flaccidum* (Meisn.) Steward. Fukien: Sanyuan, Shayang (三元沙洋), Apr. 29, 1942 (Chen. 154). On *Polygonum hydropiper* L. (var. indeterm.). Fukien: Yuntai, Wutungwei (永泰梧桐尾), June 5, 1942 (Chen. 214).

The fungus was known by the name *Ustilago utriculosa*. The species of this genus on many *Polygonum* were considered identical until Liro showed that they are not intercommunicable. *U. Cordai* Liro has been reported on *Polygonum Blumei* Meisn., *P. nodosum* Pers, etc. It is closely allied to *U. anomala* Kuntz but this latter differs in the light brown epispore with much smaller reticulations.

The sporogenous hyphae may be observed in young sori. they are much branched, shorttly and transversely septate into numerous swollen cells. Within these cells, spores are borne endogenously by rounding off, being coated with reticulate epispore, while the overlapped hyphal wall becomes gelatinized and finally disappears.

SPHACELOTHECA De Bary

Verg. Morphol. u. Biol. Pilz. 187 (1884)

SPHACELOTHECA TONGLINENSIS (Tracy et Earle) Ling et Chen, comb. nov.

Ustilago tonglinensis Tracy et Earle, in Bull. Torr. Bot Club, XXII, 175 (1895); Sacc., Syll. Fung., XIV, 420 (1899); Petch., in Ann. Roy. Bot. Cand. Paradenya, V (4), 225 (1912); S. Ito, Myc Fl. Jap., II, 19, fig. 14 (1936); Teng, in Sinensia, VII (2), 261 (1936).

Sori in ovaries, concealed by enveloping floral parts which remain intact forming slightly swollen bodies, about 2 mm. in length and half as long as the outer glumes, covered by a firm cream colored false membrane which is composed of sterile hyphal cells and host epidermis, this rupturing from the apex downwards and allowing the escape of dusty black spore mass, leaving finally behind a distinct central columella;

columella simple, often branched at the apex, slender, up to 4 mm. long, composed of host tissues and sterile fungous threads, usually subtended at the base by the undissipated lower portion of false membrane. All ovaries of the infected host plant being injured without exception.

Spores globose, ovoid, rarely angular-globose, nearly equal, usually 10–13 μ in diameter, with few mycelial fragments adnate to the wall. epispore dark brown, about 1.3 μ thick, with prominent strong and thickened echinulations; sterile cells hyaline, subglobose, ovoid, smooth, about as large as spores, connected in chains and firmly bounded together into a thickly layered false membrane.

Habit: On *Ischaemum ciliare* Retz. Fukien: Yungan, Moping（永安茅坪）, May 5, 1942 (Ling. 2161); Yungan, Hwangli（永安黃歷）, Sept. 20, 1942 (Chen. 273); Yuntai, Gaiyang (永泰蓋洋), June 12, 1942 (Chen. 229); Sanyuan, Sinkow（三元莘口）, April 26, 1942 (Chen. 139); same loc., April 25, 1942 (Chen. 136).

The specimens cited above agree well with the description of this species as given by S. Ito, but not so exactly with the original diagnosis of Tracy and Earle in the measure of spores (8–13 μ after S. Ito, 9–11 μ after Tracy and Earle).

On account of the presence of a cream white false membrane consisting of a rather thick layer of fungous sterile cells, this species is not and cannot be referred to the genus *Ustilago*. A new combinaison of name therefore is suggested. Moreover, the feature of spore formation seems to illustrate this viewpoint. Around the central columella of young sorus, there arise from the thick mat of interwoven mycelium numerous radically disposed sporogenous hyphae directing outwards. Spores are borne from this hyphae in a centripetal manner. They are catenulately disposed with the inner ones the youngest. Subsequent developmental stages consist a thickening of epispore accompanied by some destruction of intermixed hyphae end finally a maturing of spores accompanied by a disappearance of over-coating hyphal membrane. The procedure is here essentially the same as Clinton showed it in other members of *Sphacelotheca*.

SPHACELOTHECA SACCHARI Ling et Chen sp. nov.

Syn. (?) *Ustilago Sacchari* Rabenhorst, Sitzungsber, Isis 1870, 227; in Hedw. X, 18 (1871); Teng, in Sinensia, VII, 258 (1936), non Fisch. d. Waldh.

(?) *Cintractia Pulverulenta* Cooke et Massee, sensu Sydow, in Ann. Myc., XII, 486 (1924).

Sori ovariicoli eaque in corpuscula ellipsoidea apice acutiuscula vel interdum breviter bifida 2.5–3.5 mm. longa 0.6–0.8 mm. crassa transformantes, primo membrana opace brunneo-alba e cellulis sterilibus hyalinis levibus catenulatis varie magnitudinis composita tecti, demum circiter dimidium erumpentes, basi tunicati, massis sporarum

atris pulverulentes, columella centrali simplici vel, breviter ramosa e contextu ovarii myceliisque constituta exhibentes; sporae sphaeroideae, ovoideae, rarius anguloso-globosae, 6.5–10 μ diam. vel 4.5–8 × 6.5–11 μ metientes, saepe fragmentis hypharum adnate, episporio sature brunea crebre minuteque echinulata praeditae. Habit: in ovariis *Sacchari arundinacei* Retz.

Sori in ovaries, entirely destroying them, forming slightly swollen bodies, usually acute and sometimes shortly forked at the apex, abont 2.5–3.5 mm. long and 0.6–0.8 mm. cross, concealed at first by enveloping glumes which remain inaltered, covered for some time by a grayish cream colored false membrane which is composed of thickly layering sterile fungous cells; this becoming ruptured on the upper half portion and disclosing the black dustty or granular spore mass, leaving finally behind the cupule-shaped base of false membrane and the central simple or shortly branched columella which is composed of host tissues and fungous threads.

Spores subglobse, ovoid, or subangular through mutual pressure, rarely irregular, 6.5–10 μ or 4.5–8 × 5.5–11 μ, connected at first in chains by minute mycelial fragments which remain attached to the wall of mature spores; epispore dark brown, minutely echinulate; sterile cells hyaline, subglobose to oblong, catenulate or diversely grouped, as large as or larger than spores.

Habit: On *Saccharum arundinaceum* Retz. Fukien: Shahsien, vicinity of city (沙縣城郊), Aug. 10, 1941 (Chen. 32); Yuntai, Wutungwei (永泰梧桐尾), June 5, 1942 (Chen. 211).

This *Sphacelotheca* bears some resemblance in its spore size and sorus form to *Ustilago Sacchari* Rabh. of which we have seen no authentic specimen and may be suspected to be identidal to that species. *Cintractia pulverulenta* Cke. et Mass. was doubtly reduced by Teng to *Ustilago Sacchari* Rabh. *Cintractia pulverulenta* and *Ustilago Sacchari* are found respectively by Sydow and Teng also on *Saccharum arundinaceum* besides other host plants. But an examination of our specimens in hand shows that Sphacelotheca is clearly the proper genus, sharply defined by its false membrane being composed of sterile hyphal cells, and by its catenulately disposed spores which mature in centripetal succession. If correctely placed within this genus, this species is allied to the Japanese *S. Penniseti-Japonici* (P. Henn.) S. Ito, differing chiefly in the size of spores.

SPHACELOTHECA POLYGOPNI-SENTICOSI (P. Henn.) Miyake et Takahashi, in Trans. Sapporo Nat. Hist. Soc., XIV, 90 (1935); S. Ito, Myc. Fl. Jap., II, 53 (1936).

Ustilago polygoni-senticosi P. Henn., in Litt. (白井, 目錄. I. 113 1912).

Sori in ovaries, at first surrounded by the host perianth, then prominent, forming

swollen spherical bodies up to 5.5 mm. in length, covered by a grayish white false membrane which soon wears away revealing the dusty purplish black spore mass, leaving behind a prominent colunmella up to 0.8 mm. in height. All ovaries from an inflorescence or from a same host may be injured.

Spores subglobose, ovoid, rarely irregular, usually 8—13 μ, often connected in chains by the mycelial fragments which remain attached to the wall, epispore purple brown, finely echinulate; sterile cells hyaline, smooth, catenulate or variously grouped, as large as or larger than the spores.

Habit: On *Polygonum senticosum* Fr. et Sav. Fukien: Sanyuan, yankotzu (三元羊口仔), April 24, 1942 (Chen. 130); Shahsien, Chengtow (沙縣鎮頭), Oct. 4, 1942 (Chen, without no.).

The species is characterized by having the prominent columella and the echinulate spores; it is nearly related to *S. granosa* Liro.

SPHACELOTHECA HYDROPIPERIS (Schum.) De Bary, Verg. Morph. u, Biol. Pilz. 187, fig 80 (1884); Schröt., Pilz. Schles., I, 275 (1887); Sacc., Syll. Fung., VII, 499. (1888); Plowr., Monogr. Brit. Ured. & Ustil., 282 (1889); Clint., in Proc. Bost. Soc. Nat. Hist., XXXI, 394 (1904); Schell., Beitr. Krypt. Schw., III (2), 65, fig. 35 (1911); Lindau, Krypt. Mark. Brand., Va (3), 35, fig. 15 (1912); Bubak, Pilz. Böhm., II, 28. fig. 12 (1916); Liro, Ustil. Finn., I, 2 (1924); S. Ito, Myc. Fl. Jap., II, 50 (1936).

Uredo hydropiperis Schum., Enum. Pl. Saell., II, 234 (1803).

Caeoma utreculosum Nees, Syst. Pilz., 14, pl, pl. 1, fig. 6 (1817).

Ustilago utriculosum Fr., Syst. Myc., III, 519 (1829).

Ustilago hydropiperis Schrot., in Cohns' Biol. Pilz., II, 355 (1877); Wint., Pilz. Deut., I, 94 (1884).

Sori in ovaries, surrounded by the floral parts, prominent, forming ovate horn-like swollon bodies aboat 5 mm. in length, at first protected by a grayish false membrane, this soon rupturing from the apex downwards and disclosing the dusty purplisn spore mass, leaving behind a central columella abut 3 mm. long, Only a few ovaries of the inflorescence being injured.

Spores subglobose, ovoid, ellipsoidal, angular or sometimes irregular, 8.5—15 μ or 8—11.5 × 10—16 μ, occasionally np to 10 × 21.5 μ, purplish brown, very minutely echinulate; sterile cells of false membrane hyaline, as large as spores.

Habit: On *Polygonum Posumbu* Ham. Fukien: Liencheng, Makiaping (連城馬甲坪), Oct. 15, 1943 (Wang 1072).

The species is readily distinguisheed from some other nearly allied species by the spores being various in size, very minutely echinulate and apparently smooth under

objective of low power.

FARYSIA Raciborski

Bull. Acad. Sc.Crac 354 (1909).

FARYSIA CARICIS-FILICINAE S. Ito, in Trans. Sapporo Nat. Hist. Soc., XIV 91 (1935); et Myc. Fl. Jap. II, 60 (1936).

Sori in ovaries, converting them into prominent spherical swollen bodies about 4–6 mm. in diameter, at first compact and covered by the grayish delicate host epidermis, then becoming spongy, enlarged, soon rupturing and disclosing a black dusty mass of sterile mycelial elators and spores. All or some ovaries being infected. Elators brown colored, composed of several to numerous parallelly disposed sterile hyphae; spores borne between the elators, very variable in form and size, spherical, ellipsoidal, piriform, fusiform, attenuate at one or both ends, or irregular, usually 6.5–11 μ, or 4–9×6–15 μ, eventually up to 18 μ in length; epispore brown tinted, with minute echinulations disposed in ranges or in circles; sterile hyphae when separated hyaline or brownish, obsoletely septate, about 2.5 μ cross.

Habit: On *Carex filicina* Nees. Fukien: Yungan, Moping (永安茅坪), Nov. 12, 1942 (Chen. 307); Ningyang, Shihkang (寧洋石坑), Dec. 3, 1942 (Ling, without no.); Liencheng, Kutien (連城姑田), Sept. 1943 (Ling, without no.).

The species previously recorded from Formosa is apparently very common in our region. It is closely related to *F. olivacea* (DC.) Syd. and *F. Merrillii* (P. Henn.) Syd. (*F. japonica* Rac.); but from the former it differs in the larger and darker spores, and from the latter in the dark brownish black sori and perhaps in the color of spores.

The description given above is based on specimen Chen no. 307. The two other specimens represent a form with spores less irregular and smaller, usually 5–8 μ in diameter.

FARYSIA OLIVACEA (DC.) Sydow, in Ann. Myc., XVII, 46 (1919); Sacc., Syll. Fung., XXIII, 631 (1925); S. Ito, Myc. Fl. Jap., II, 59, fig. 59 (1936).

Uredo olivacea DC., Fl. Fr., VI, 78 (1815).

Erysibe olivacea Schlecht, Fl. Berol., II, 130 (1824).

Ustilago olivacea Tul., in Ann. Sc. Nat., 3 sér. VII, 88, pl. IV, fig. 11 (1847); Brefeld, Unters. Gesammtgeb. Myk., V, 129 (1883); Wint., Pilz. Deut., I, 91 (1884); Fisch. d. Waldh., Les Ustil. esq. Monogr., 46 (1878); Plowr., Ured. & Ustil., 277 (1889); Sacc., Syll. Fung., VII, 463 (1888); Clint., in Proc. Bost. Soc. Nat. Hist., XXXI, 354 (1904); McAlp. Smuts of Austr., 157, pl. XXIX (1910);

Lindau, Krypt. Merk. Brand., Va (8), 24 (1912).

Ustilago caricicola Tracy et Earle, in Bull, Torr, Bot. Club, XXVI, 493 (1899); Sacc., Syll. Fung., XVI, 368 (1902).

Usilago subolivacea P. Henn., in Ann. R. Inst. Bot d. Roma, VI (2), 84 Sacc., Syll. Fung., XIV, 421 (1889).

Elateromyces olivaceus Bubák, Houby Ceské Dil. II, 33 (1912), et Pilze Böhm., II, 32 (1916).

Sori destroying entirely the ovaries, converting them into spherical bodies about 1.5–2 mm. in diameter, at first compact, then slightly swollen and becoming spongy, covered by the delicate grayish host epidermis, this soon rupturing and desclosing a dusty olive black mass of sterile mycelial elators and spores. Only some ovaries being injured.

Elators light brown colored, composed of several to many parallelly disposed sterile hyphae. Spores borne between this elators, very variable in shape and in dimension, subglobose, ovoid, reniform, fusiform, angular or irregular, usually 5–9 × 5–7 μ, rarely 5–13 × 4–10 μ, epispore light brown, densely and minutely echinulate; sterile hyphae hyaline or light yellow brown, obseletely septate.

Habit: On *Carex ligata* Boott. Fukien: Sanyuan, Sinkow（三元莘口）, Apr. 25, 1942 (Chen, 138). On *Carex sp.* Fukien: Nanping, Moti（南平茂地）, March 27, 1942 (Ling Ying 115).

This widely distributed species is characterized by the finely echinulate and variously shaped spores. It is nearly allied to *F. Pseudocyeri* (Sacc.) Zundel (*Ustilago olivacea* Speg. non Tul.) which differs in having darker and less irregular spores.

CINTRACHA Cornu

Ann. Sc. Nat., Ser. 6, XV, 277 (1883).

CINTRACTIA AXICOLA (Berk.) Cornu, in Ann. Sc. Nat., ser. 6, XV, 277–278 (1883), et in Bull. Soc. Bot. Fr., XXX, 131 (1883); Sacc., Syll. Fung., VII, 480 (1888); Clint., in Proc. Bost. Soc. Nat. Hist., XXXI, 405 (1904), et N. Am. Fl., VII, 35 (1906); McAlp., Smuts of Austr., 165, pl. XXXVII, fig. 95-96 (1910); S. Ito, Myc. Fl. Jap., II, 72 (1936).

Ustilago axicola Berk., in Ann. Mag. Nat. Hist., 2. ser., IX, 200 (1852); Fisch. d. Waldh., Les Ustil., esq. Monogr., 17 (1878); Sacc., Syll. Fung., IX, 285 (1910).

Sori in the base of peduncles forming hardened subglobose elliptic fusiform and slightly swollen dodjes about 1.5–3 mm. in length and 1.5–2 mm. in width, at first covered by a rather thick firm grayish false membrane which is composed of strates of

hyaline or light yellow semigelatinized fungous threads; this soon rupturing and disclosing the black agglutinated spore mass.

Spores subglobose, ellipsoidal or shortly cylindric, 9–16 μ, or 9–13.5 × 13–17 μ, epispore smooth, 1.5 μ in thickness, brown; numerous hyaline hyphae intermixted with the spores.

Habit: On *Fimbristylis diphylla* Vahl. Fukien: Ningyang, Shihkang (甯洋石坑), Dec. 4, 1943 (Ling, without no.). On *Fimbristylis diphylla* Vahl. var. *annua* Clarke (*F. annua* Roem. et Sch.). Fukien: Yungan, Moping (永安茅坪), Sept. 21. 1942 (Chen 291); Lungyen, Luchow (龍岩蘆州), Nov. 10, 1942 (Ling, without no.).

As stated by S. Ito, the species of Berkeley is here considered as synonymy of *Cintractia axicola* Cornu, though it was admitted by Saccardo as a valid species of *Ustilago*. Our specimens from Fukien distinctly have brown colored epispore and perhaps is really different from the typical form of which the spores are described as being light brown tinted. The thickly outerlying sterile cells which constitute the false membrane are often semigelatinized and very variable in shape. But the large sterile cells, indicated by S. Ito as being intermixted with the spores, have not been observed.

A short account on the spore formation may be given as follows. Around the axial host tissues in a young sorus, there appears a strate of interwoven sterile hyphae which produces towards the periphery numerous sporogenous hyphal branches parallelly and radically disposed. Spores are developed in chains from these hyphae centripetally, the outer ones being the first to reach maturation and becoming coated with darkened epispore.

CINTRACTIA SUEDAE Sawada, Descr. Cat. Form. Fung., II, 81, pl. IV, fig. 12–16 (1922); S. Ito, in Trans. Sapporo Nat. Hist. Soc., XIV, 91 (1935), et Myc. Fl. Jap., II, 66 (1936).

Sori in ovaries, concealed at first by the enveloping floral parts, then prominent, forming spherical swollen bodies about 1.5–2 mm. in diameter, upon the rupture of covering membrane, dusty black hard spore mass becoming disclosed; spores subglobose, ellipsoidal, 9–15 × 12–18 μ, epispore smooth, red brown, about 1.5 μ thick. Only some ovaries of a spike being infected.

Habit: On *Fimbristylis diphylla* Vahl. (*F. annua* var. *diphylla* Kükenth.). Fukien: Shahsien, vicinity of city (沙縣城郊), Oct. 25, 1942 (Chen 306).

Only one specimen being collected, described by the junior auteur of this paper.

CINTRACTIA FIMBRISTYLIS-KAGIENSIS Sawada, Descr. Cat. Form. Fung., II, 97 (1922); S. Ito, in Trans. Sapporo Nat. Hist. Soc., XIV, 91 (1935) et Myc.

Fl. Jap., 65 (1936).

var. FUKIENENSIS Ling et Chen, var. nov.

A typo differt sporis paullo minoribus 9.5–15 μ diam. vel 8.3–13.5 × 11.5–15 μ metientibus, soris duriusculis. Habit: in ovariis *Fimbristylis schoenoides* Vahl.

Sori in ovaries, at first concealed by the enveloping glumes, then prominent and forming subglobose swollen bodies of 2–3 mm. in diameter, covered at first by a brownish white delicate host epidermis, this soon rupturing and disclosing a hard compact agglutinated spore mass. Only two or three ovaries of an inflorescence being injured and infection often limited in the lower portion of ovaries, the style and its constricted base being left intact.

Spores subglobose, ellipsoidal, the inner ones often subangular, 9.5–15 μ or 8.3–13.5 × 11.5–15 μ, often with two to severl minute hyphal fragments attached to the wall; epispore smooth, adout 1 μ thick, yellowish brown; sterile hyphae hyaline, abundant, intermixted with spores.

Habit: On *Fimbristyles schoenoides* Vahl. Fukien: Yungan, Moping (永安茅坪), Sept. 10 1942 (Chen 292).

This *Cintractia* is here tentatively referred as a variety to the Formosan *C. Fimbristylis-Kagiensis* Sawada which occurs on a different species of *Fimbristylis*. These two fungi are at least closely allied and distinquished one another only by slight difference in size of their spores.

CINTRACTIA PILULIFERA Ling et Chen, sp. nov.

Sori ovaricoli eaque in corpuscula sphaeroidea dura 2–3 mm. crassa transeuntes, primo epidermide ovarii brunneo-alba cincti, dein massis sporarum compacte agglutinosis atro-brunneis erumpentes. Sporae sphaeroideae ellongato-ellipsoideae vel rarius angulatae, 11–16.5 μ diam. vel 8–11.5 × 13.5–17.5 μ metientes, saepius fragmentis mycelii minutis adhaerentes, epispora levi lutescenti-brunnea vel sature brunnea 1 μ crassa praeditae. Habit: In ovariis *Fimbristylis diphyllae* var. *pluricostatae* Clarke.

Sori in ovaries destroying all or the basal part, concealed at first by the host glumes, then prominent forming spherical swollen bodies about 2–3 mm. in diameter, covered by the brownish albescent host epidermis, this soon rupturing and disclosing a hard compact brownish black spore mass. Several ovaries of a spiklet usually being infected.

Spores subglobose, ellongated-ellipsoidal or angular through mutual compression, often with some mycelial fragments attached to the wall, 11–16.5 μ or 8–11.5 × 13.5–17.5 μ; epispore about 1 μ thick, smooth, yellowish or dark brown.

Habit: On *Fimbristylis diphylla* var. *pluricostata* Clarke (*F. pilosa* auct.

plur. non Vahl.). Fukien: Yungan, Moping (永安茅坪), Sept. 10, 1942 (Chen 292).

The species differs from the preceding *C. Fimbristylis-Kagiensis* Sawada in the form of spores and the hard agglutinated spore mass. The nearly allied species seems to be *C. miliaceae* (P. Henn.) S. Ito which is distinguished by the horn-like sori and the smaller spores.

In the spore formation, the central portion of sorus is filled with hyaline hyphae interwoven to a false tissue, which towards the periphery give rise to numerous parallely and radically disoosed sporogenous branches. Spores arise from this latter in a centripetal succession, with the inner ones the youngest. The spores mature in a similar way as that of other known *Cintractia*.

CINTRACTIA PULCHRA S. Ito, in Trans. Sapporo Nat. Hist. Soc., XIV, 92 (1935), et Myc. Fl. Jap. II, 6 ? (1936).

Sori in ovaries, concealed at first by the floral parts, then prominent, forming subglobose swollen bodies up to 0.8—1.2 mm. in diameter, at first covered by a grayish false membrane which is composed of a relatively thick layer of semigelatinized fungous threads, this rupturing and disclosing a black hardened spore mass. Only a few ovaries of an inflorescence being injured.

Spores subglobose, ellipsoidal, rarely irregular, usually 8-14 × 7-12 μ, sometimes intermixted with special large spores, which are spheroidal, ellipsoidal, 14—18 μ in magnitude; epispore yellowish brown, sharply echinulate with minute polygonal reticulations; sterile hyaline hyphae abundant, intermixted with spores.

Habit: On *Fimbristylis miliacea* Vahl. Fukien: Yungan, Moping (永安茅坪), Sept. 25, 1942 (Chen 289); same loc., Oct. 1, 1942 (Chen, without no.).

Though the characters of fine reticulate ornamentation of epispore and the occasional presence of special large spores were not commented by S. Ito, the specimen from Fukien does not seem to represent a form distinct from the Japanese type which occurs also on *Fimbristylis miliacea* Vahl. We are therefore led to believe that this belongs here; but the final judgement cannot be made until Ito's specimen is examined.

SOROSPORIUM Rudolph
Linnaea IV, 116 (1839)

SOROSPORIUM ARUNDINELLAE Sydow, in Hedw. XL, P. (2), (1901); Sacc., Syll. Fung., XVII, 484 (1905); S. Ito, Myc. Fl. Jap. II, 96 (1936).

Sori in ovaries, more or less concealed by the floral parts, forming spherical, ovoid or cuneiform hard bodies about 1—1.5 mm. in downwards disclosing the dark greenish

black spore mass.

Spore glowerules ovoid, ellipsoidal, 40—64 × 80—120 μ, black, opaque, composed of several hundreds of spores; spores globose, ovoid, or angular through mutual compression, yellowish to dark brown, 5—7 μ; epispore prominently verrucose.

Habit: On *Arundinella anomala* Steudel. Fukien: Ninyang, Hushan (甯洋虎), Dec. 4. 1943 (Ling, without no.).

SOROSPORIUM PASPALI-THUNBERGII (P. Henn.) S. Ito, in Trans. Sapporo Nat. Hist. Soc., XIV, 95 (1935), et Myc. Fl. Jap. II, 81 (1936).

Ustilago Paspali-Thunbergii P. Henn., in Hedw. XLIII, 140 (1904); Sacc., Syll. Fung., XVII, 478 (1905); P. Henn. in Engl. Bot. Jahrb., XXXIV, 593 (1905); Sydow, in Ann. Myc., VII, 173 (1903).

Sorosporium Paspali Mc Alp., Smuts of Austr., 180, pl. XLIV, fig. 137—139 (1910); Sacc., Syll, Fung., XXI, 513 (1912).

Sori in inflorescence destroying all the part at early time, hidden at first by the leaf-sheath, then throwing off, forming elongated whip-like body up to 20 cm. long, distorted, with upper part often remaining attached to the leaf-sheath, at first covered by a firm grayish or brownish false membrane composed of sterile fungous cells; this rubturing, the black dusty spore mass becoming scattered and leaving being the central filiform ramified columella. Inflorescence being entirely or partially infected.

Spore glomerules ovoid, globose, usually about 50 μ in diameter, composed of 10—30, or in the smaller ones, of 3—5 spores, black, opaque, surrounded at first by a hyaline hyphal envelope which soon gelatinizes and disapears; spores ellipsoidal, angular through compression or very irregular, 10—20 × 6—16 μ; epispore dark brown, very finely echinulate; sterile cells of the false membrame hyaline, similar to those of ordinary hyphae, but somewhat larger in dimension.

Habit: On *Paspalum scrobiculatum* Linn. Fukien: Sayuan, Sinkow (三元莘口), Apr. 25, 1942 (Chen 137); Yungan, Hwangli (永安黃歷), Sept. 2o. 1942, (Chen 281); Shahsien, Changtow (沙縣鎮頭), Oct. 4. 1942 (Chen, without no.).

The elongated filiform sori may arise either from a whole inflorescence or from a single spike branch. In the former case, they are characterized by the possession of larger and branched columella, while in the latter the sorus axis is usually simple. After the rupturing the firm false membrane often remains attached to the columella.

SOROSPORIUM HOLSTII P. Henn., Pilz. Ostafr. 46 (1895); Sacc., Syll. Fung., XIV, 428 (1890); Shen, in Sinensia, IV, 314 (1934).

Sphacelotheca exserta Yen, in Contr. Inst. Bot. Acad. Peip., III, 5 (1935).

Cintractia exserta Yen, loc. cit., non McAlp.

Sori in spiklets, usually entirely destroying the floral parts, protected at first by the floral bracts, then throwing out and forming elongated filiform bodies about 1.8–2 cm. long and 1.5–2 mm. broad, covered by a rather firm grayish albescent false membrane which is composed of host tissues and fungous threads; upon the rupture, the dark black granular or agglutinated spore mass becoming scattered, leaving finally behind a columella composed of host tissues.

Spore glomerules globose to oblong, 30–70 μ in diameter; spores subglobose, ellipsoidal, or angular through mutual pressure, 6.5–12 μ, or 6.5–10×8.5–12 μ, epispore yellowish brown to dark brown, minutely echinulate.

On *Themeda gigantea* (Cav.) Hack. Fukien: Ninyang, Ta-hwei ([illegible]), Dec. 1, 1943 (Ling, without no.).

The species has been recorded from China on *Themeda triandra* Forsk. *Sphacelotheca cristata* Yen, described as having smaller spores, does not seem to be distinct from this species.

SPOROSPORIUM FORMOSANUM Sawada, Descr. Cat. Form. Fung., VI, 29 (1923); S. Ito, Myc. Fl. Jap., II, 82, fig. 80 (1936).

Ustilago formosana Sawada, in Journ. Form. Nat. Hist. Soc., no. 34, 6–8 (1918), et Descr. Cat. Form. Fung., I, 326, pl IX, fig. 28 (1919); Sacc., Syll. Fung., XXIII, 612 (1925); Tanaka, in Mycol., XIV, 89 (1922).

Sori in infloresecence, destroying all the part when this is yet hidden in the leaf-sheath, forming elongated filiform body, at first covered by a brownish white false membrane constituted of fongous sterile cells, son becoming ruptured, disclosing a dusty black spore mass, leaving at last behind many fine fibrous columellae which represent the remainders of host peduncles. Infloresecence being injured entirely or sometimes partially.

Spores glomerules ovoid, reniform, 30–120 μ in diameter or up to 96×160 μ, dark black, opaque, surrounded at first by a hyaline hyphal envelope which soon becomes gelatinized and disappears; spores globose, ovoid, or angular through mutual pressure, 5–8 μ; epispore light brown, very minutely echinulate (appearing smooth under objectif of low power); sterile cells of false membrane hyaline, ovoid, oblong, two to five times larger than spores.

Habit: On *Panicum repens* Linn. Fukien: Yungan, Moping (永安岩坪), Dec. 17, 1942 (Ling, without no.); same loc., May 5, 1942 (Ling 2155); Yuntai, Tsingyuan (永泰清源), June 4, 1942 (Chen 207).

Apparently very common in this province, the species is characterized by relatively small and finely echinulate spores which are grouped in great number into spore glomerules.

SORCSPORIUM FLAGELLATUM Syd. et Butler, in Ann. Myc. V. 489 (1907); Sacc., Syll. Fung., XXI, 512 (1912); S. Ito, Myc. Fl. Jap., II, 82 (1936).

Sori in inflorescence destroying all the part, at first hidden in the leaf-sheath, then throwing out and forming elongated filiform body about 4–8 mm. in length, tortuose on the upper portion, covered by a grayish delicate false membrane which is composed of sterile fungous cells; this soon rupturing, the granular black spore mass becoming scattered, finally leaving behind one or two filiform central columellae composed of inflorescence axis. All spikes of a host plant being injured.

Spore glomerules ovoid, oblong, or subglobose, up to 80×160 μ, usually composed of 30 to 70, rarely less than 10 or more than 100 spores surrounded at first by hyaline hyphae which soon gelatinize and disappear; spores subglobose, ovoid, or angular through mutual pressure, 9–16×8–15 μ; epispore dark brown, minutely echinulate, sterile cells of false membrane catenulate, subglobose, oblong, as large as the spores, or two to three times larger.

Hadit: On *Ischaemum ciliare* Retz. Fukien: Yuntai, Gaiyang (永泰蓋洋), June 12, 1942 (Chen 230).

The spore formation may be amply described as follows. The primordia of spore glomerules are borne in the young sori filleed with a stroma of interwoven hyphae. They are grouped in great number, consisting of a sort of mycelium balls, easily distinct because of their closely coiled structure and thicker cell contents. The fertile cells are nearly always centrally located in these mycelium balls. They become rounded off and coated with thicker membrane, and develope through disintegration into mature spores. The outerlying coiled mycelium which surround the spore glomerules is left intect until spore maturity is reached and finally gelatinizes and disappears.

SORCSPORIUM ANDROPOGONIS-MICRANTHI Ling et Chen. sp. nov.

Sori in inflorescenciis evoluti eisque omnino destruentes, nec non in parte spicarum deficientes, elangati, teretes, lineares, 2–4 mm. longi, circ. 3 mm. crassi, vagina foliari partim inclusi, primo membrana cinereoalba e cellulis sterilibus hyalinis catenulatis composita tecti, mox erumpentes, massis sporarum atris granulatis pulvulentes, columella centrali simplici vel breviter ramosa e contextu inflorescentii constituta exhibentes; glomerulae sporarum sphaeroideae, ellipsoipeae atro-brunneae, multisporae, circ. 80–200 μ diam.; sporae globosae, ovoideae, vel mutua pressione angulatae 6–11 μ diam., epispora dilute brunnea subtilissime echinulata praeditae. Habit. in inflorescentiis *Andropogonis micranthi* Kunth.

Sori in inflorescence destroying all the part or located on some branches of pani-

cle, at first hidden by leaf-sheath, then throwing out forming elongated filiform-cylindric bodies about 2—4 cm. in length and 3 mm. in width; covered by a delicate grayish white false membrane which is composed of fungous sterile cells; upon the rupture of this, the dark black granular spore mass becming scattered, leaving finally behind a simple or branched columella compored of host tissues. sori which arise from a single inflorescence branch are usually smaller in size.

Spore glomerules subglobose, ellipsoidal, dark brown, opaque, 80—100 μ in diameter, usually composed of 50—200 spores, surrounded by a coat of mycelium which soon gelatinizes and disappears; spores globose, ovoid, or angular through compression, 6—11 μ in diam. or 10—12 × 6—8 μ, epispore light brown, very minutely echinulate; sterile cells of false membrane hyaline, smooth, oblong to angular, connected in chains, as large as spores.

Habit: On *Andropogon micranthus* kunth. Fukien: Yungan, Moping (永安茅坪), Sept. 26, 1942 (Chen 294); Shahsien, vicinity of city (沙縣城郊), Oct. 15, 1942 (Chen 300).

This *Sorosposium* is apparently related to the American *S. Ellisii* spores. It may also be compared with *S. Simii* Pole Evans and *S. marrangensis* P. Henn., which differ either in the very large sori or in the smooth spores.

The species undoubtely belongs here and there is no confusion with *Ustilago Taiana* Syd. which has been reported also on *Andropogon micranthus* Kunth. The spore formation, essentially the same as that of other known *Sorosporium*, begins by the apparition of coiled mycelium constituting the primordial spore glomerules. Moreover the characteristic hyaline hyphal envelope wh(ch surrounds the matrre spore ball may also be easily observed.

TOLYPOSPORIUM Woron.

Abk. Senck. Nat. Ges. XII, 577 (1882).

TOLYPOSPORIUM BULLATUM (Schröt.) Schröt., Pilz. Schles., I, 276 (1887); Sacc., Syll. Fung., VII, 502 (1888); Clinton, in Proc. Bost. Soc. Nat. Hist., XXXI, 429 (1904), et N. Am. Fl., VII, 44 (1906); Bubák, Pilze Bohm., II, 35 (1916); S. Ito, Myc. Fl. JaP., II, 86, fig. 84 (1936).

Sorosporium bullatum Schröt., Abh. Schles. Ges. Kult., 1869—72, 6 (1869); Fisch. d. Waldh., Apercu Syst. d. Ustil., 313 (1877); et Les Ustil. esq Monogr., 60 (1878); Rabh., In Hedw., X, 3 (1871); Wint., Pilz. Deut., I, 104 (1884).

Sori in ovaries destroying them entirely, at first concealed by the floral parts, up to 4.5 mm. in length and twice as large as normal grains, covered by a firm green or grayish green membrane of host epidermis, in time this rupturing, and allowing

the escape of black granular spore mass. Only some ovaries of a spike being infected and sori sometimes falling in whole.

Spore glomerules black, opaque, spherical, ovoid, or irregular, firmly agglutinated, 160—460 × 100—240 μ or 100－240 μ in diameter, composed of several hundreds of spores; spores spheroidal, ovoid, ellipsoidal, polyedral, usually 7—10 μ or 10—12 × 6—8 μ, firmly connected by the thickened projections of epispore; epispore light yellow to light brown, or hyaline, thick, ridged. often spiny, obsoletely verrucose-Punctate, with several thickened projections.

Habit: On *Echinochlca Crus-galli* Beauv. subsp. *colona* Honda var. *edulis* Honda. Fukien: Shahsien, vicinity of city (沙縣城郊), Oct. 20, 1942 (Chen 202). On *Echinochloa Crusgalli* Beauv. subsp. *Colona* Honda var. *typica* Honda, same loc., Oct. 20, 1942 (Chen 203); Yungan, Moping (永安茅坪), Sept. 1941 (Ling. without no.)。

ON A NEW SPECIES OF PHLEBOTOMUS FOUND IN FUKIEN, CHINA

C. C. Tang and T. Maa.

福建白蛉之新種

唐仲璋　馬駿超

As in the case of most of the blood-sucking insects in China, very little is known regarding the species of "sandflies". Up to the present only seven species and one variety of *Phlebotomus* have been recorded from this country. Thus far, in the south eastern provinces such as Chekiang, Kiangsi, Fukien and Kwangtung no report has ever been made for this particular group of insects. After prolonged and careful searches, a number of "sandflies" were collected in Ma-Sha (麻沙), Shaowu (邵武), and Yungan (永安), Fukien Province between September, 1943 and October 1945. A detailed morphological study shows that they belong to a *Phlebotomus* species which is new to Science. The name *Phlebotomus hoepplii* is proposed in honor of Professor R. Hoeppli of Peiping Union Medical College. Full descriptions of both male and female are given in the present communication. Following the system of Franca and Parrot (1920) and of Sinton (1923), measurements were taken on several specimens of each sex and results recorded in the appended tables.

Description of fresh specimens

The general color of the insect is grayish. The integument of the thorax and abdomen is light yellowish. The black eyes give a marked contrast to the rest of the body.

The abdominal hairs are erect on the dorsum, forming tufts from abdominal segment II to segment VI. The antennae are hairy and wings are covered with numerous gray hairs.

Description of mounted specimens

I. The Male Insect

The total length of the body is 1.64–1.76 mm. with an average of 1.68 mm. which is about 0.51 times the length of the hind leg and about the same length of the wing.

The Pharynx (Pl. I, Fig. 3.) is about 4 times as long as broad, markedly dilated posteriorly. The pharyngeal armature is unique in morphology. At the posterior part it is composed of a series of oblique ridges radiating from the middle, while on the either side of the anterio-lateral porton there are a number of sharp teeth projecting backward and converging toward the middle line. There is no pigmented area and the buccal cavity is unarmed.

The Antennae have a total length of 1.40—1.51 mm. with an average of 1.49 mm. Paired geniculate spines are found on all segments from the IIIrd to XVth inclusive, thus giving the antennal formula 2 over III to XV. The geniculate spines are long with their apices extending as far as, or, rarely surpassing the next inter-segmental articulation (Pl. I, Fig. 2). They tend to be asymmetrical in position and length.

The Palps have a formula of 1, 4, 2, 3, 5. The proportionate lengths of the segments in order are 5.2, 16.0, 22.5, 10.0, 28.0. There are ten to twelvo Newstead's spines on the middle of the third segment.

The Wings (Plate 1, Fig. 1) closely resemble those of *Phlebotomus stantoni* Newstead (= *mayneі* Sinton, vide Raynal et Gaschen, 1934) as figured by Sinton (1930)[1] both in general shape and in venational ratios, except that the relative length of alpha in terms of beta is distinctly longer.

The Hind Leg is about 5.3 times as long as the femur, which is shorter than the tarsal segments II to V.

1. Figured under the name *P. maynei*.

The Male Genitalia (Pl. 1, Fig. 4) are very characteristic. The distal segment of the superior clasper is spindle in shape bearing four macrochaetae. Two stout and curved ones arise respectively from an apical and a subapical tubercle and two proximal macrochaetae, which are more slender, arise from tubercles situated on the inner side at about the basal two fifth of the segment. The distal end of the apical macrochaeta is often spatulate. The proximal segment of the superior clasper is long and slender and bears on its inner side a collection of very long hairs.

The intermediate appendage consists of three lobes, which are similar in shape to those of *P. stantoni*, except that the small ventral lobe in most of the specimens dissected bears three curved spines instead of two. At the point of its junction with the intromittent organ there arise two long spines (Pl. 1, Fig. 5), such as found by Sinton (1925, 1926, 1930) in *P. argentipes*, *P. newsteadi* and *P. stantoni*.[2] They run backward on either side of the intromittent organ and are considerably longer than the latter structure.

The intromittent organ (Pl. 1, Fig. 5) is well developed with an oval bifid end. The genital filaments are greatly protruded. The subgenital lamellae have narrow club-like distal portions, while their lower parts are connected together in one piece. No special features are found in the inferior clasper.

II. The Female Insect

The body is from 1.513 to 2.717 mm. in total length with an average of 1.87 mm. It is about 0.64 times the length of the hind leg and 1.02 times the length of the wing.

The Antennae (pl. 2, Fig. 5.) have a total length of 1.181~1.576 mm. The IVth Vth and VIth segments are approximately equal in length. The third segment is longer than the IVth and Vth taken together but is shorter than segments XII to XVI. Long and paired geniculate spines are found on all segments from IIIrd to XVth inclusive, giving the formula 2 over III to XV. Those on the more proximal segments have their ends surpass the next inter-segmental junction and are somewhat asymmetrical in length.

The palps (Pl. II. Fig. 4.) are characterized by a very short IVth segment, having a formula 1,4,2,5,3. Relative lengths of the segments are 5.8, 17.8, 25.3,

2. = *P. mayuci* Sinton

10.0, 19.8 respectively.

The pharynx has its posterior part markedly dilated. It is about three times as long as broad. The pharyngeal armature consists of a series of faint transverse and slightly oblique lines in the posterior portion. These ridges become more conspicuous as they advance more anteriorly, while in the anterio-lateral portion on either side there are a number of teeth pointing backward. In the middle line anteriorly several rows of small teeth are very significant. In the anterior-most region some of these teeth are also pointing backward toward the center

The Wings (Pl. II, Fig. 1.) are long, broad, and asymmetrical in outline, with costal margin slightly more curved than the anal. The ratio of length to breadth is 3.38.

The Hind Leg is relatively long. It is about 5 times as long as the femur, 2.6 times the tibia, and 4 times the tarsal sagment I.

The Spermatheca (Pl. II, Fig. 3.) is of the "crenulated type", as in the other members of the "erect-haired" group, It is fusiform in shape. The "Head" is small and the "Neck" is short. Its general appearance is very similar to those of *P. argentipes*, *P. colabaensis*, *P. philippinensis* and *P. stantoni*, but can be differentiated from all of them by its fusiform shape and the small apical segment with the exception of *P. stantoni*. From the latter species it can be further distinguished by the possession of very short spermathecal ducts which unite almost immediately near the base of both spermathecae. The common duct is long and comparable to that of *P. stantoni*. In the fresh condition the spermatheca possesses a large distal bulb and a sheath enveloping the whole chitinous structure.

Diagnostic Characters

The present new species belongs to the "erect-haired" group of "sandflies" especially to those forms possessing four spines on the distal segment of the superior clasper (cf. Sinton 1932, 1933). It is chiefly characterized by its pharyngeal armature, male genitalia as well as spermatheca and is definitely distinguishable from any of its cogeners. It stands, however, nearest to *P. stantoni* Newstead (= *maynei* Sinton). In the following table the more important characters of these two species are compared.

	P. STANTONI NEWST. (= *maynei* Sinton) (male)	*P. HOEPPLII Sp. n.* (male)
Size	Larger 2.33 mm. in total length	Smaller 1.575–1.75 mm. in total length
Pharyngeal armature	A series of oblique ridges radiating from the middle line and ending in loops laterally	A series of ridges at the posterior part of the pharynx, and a number of teeth on the anterio-lateral region projecting backward toward the middle line.
Wing	$\frac{\alpha}{\beta}$ 1.64 $\frac{\partial}{\alpha}$ 0.14	$\frac{\alpha}{\beta}$ 2.08–2.46 $\frac{\partial}{\alpha}$ 0.18–0.33
Hind Leg	Relatively shorter total length 3.43 mm. = 1.47 times body length	Relatively longer total length 2.92–3.51 mm. = 1.96 times body length
	Femur as long as tarsal segments II to V.	Femur shorter than tarsal segments II to V.
Male Genitalia	Proximal segment of superior clasper with hairs of moderate length	Proximal segment of superior clasper with very long hairs
	A spine on each side of the intromittent organ not longer than the latter	A spine on each side of the intromittent organ much longer than the latter
	Genital filament not protruded	Genital filament protruded.

	STANTONI NEWST. (female)	*P. HOEPPLII Sp. n.* (female)
Size	Larger 2.40 – 2.61 mm. in total length	Smaller 1.513 – 1.970 mm. in total length
Pharyngeal armature	In the middle region anteriorly there are a number of long and pointed teeth which blend with the ridges laterally	In the middle region anteriorly there are several rows of small and short teeth and in the anterio-lateral portion on either side there are a number of teeth pointing backward.
Palpal formula	1, 2, 4, 3, 5.	1, 4, 2, 5, 3.
Wing	$\frac{\alpha}{\beta}$ 1.5 – 1.6	$\frac{\alpha}{\beta}$ 1.74 – 2.33
Spermatheca	With comparatively longer spermathecal ducts united at quite a distance from the base of spermathecae to form the common duct.	With very short spermathecal ducts united near the base of the spermathecae to form the common duct.

Collecting data

The descriptions given above are based upon fifteen specimens (five males and ten females). The first female was found by one of us (T. Maa) from a small temple in Ma-Sha, Kien-Yang Hsien, in September, 1943, while some later time (Sept. 1943 to July 1944) the male and numerous female specimens were secured by Tang in the campus of Fukien Christian University, Shaowu Hsien, northwestern Fukien. In October, 1945 two male specimens of the same species were found in Yungan Hsien in the central part of this province.

Holotype (male). allotype (female) as well as thirteen paratypes (4 males 9 females) are in Tang's collection, while one further paratype (female) is in Maa's collection.

Breeding Habits

Both male and female frequent human dwellings. The females probably feed on human blood as the attempts to attract them with the human baits have been successful on several occasions. There are two breeding seasons in a year. The first is from the later part of April to the middle of July. The second season is in September and October. One female lays about thirty eggs in captivity. The egg measures 0.306 mm. in length and 0.087 mm. in transverse diameter. The chorion shows elongated areas of different length and width (Pl. II Fig. 6). In appearance it resembles closely the egg of *Phlebotomus chinensis* as described by Patton and Hindle (1928).

Acknowledgement

We wish to express our sincere gratefulness to Dr. J. A. Sinton for his kind advice and to Dr. Joseph Needham and Dr. Y. T. Yao for securing and sending to us a number of necessary literature relating to the taxonomy of *Phlebotomus*. Their kind helps are more to be appreciated during the war-time when the communication between science workers are so difficult. We wish also to thank Dr. T. H. Cheng for his interest in this work.

Table I. Measurement of male flies

Length in mm. of 5 specimens

	Structure	1	2	3	4	5	Remarks, Relative lengths etc. (average of 5 specimens)
Body	Clypeus and Head	.324	.332	.297	.324	.324	
	Thorax	.499	.437	.411	.411	.455	
	Abdomen proper	.735	.700	.656	.726	.700	
	Superior clasper Seg. I.	.203	.171	.277	.198	.207	
	Total	1.761	1.640	1.641	1.659	1.686	Average 1.677 mm.
Mouth	Labium	.210	.192	.192	.201	.210	
	Pharynx Length	.162	.162	.162	.160	.162	
	Width	.041	.041	.041	.041	.041	
Antenna	Segment III	.262	.271	.280	.280	.271	III>IV+V ; IV=V=VI
	Segment IV	.105	.105	.105	.114	.114	III<XII—XVI
	Segment V	.105	.105	.105	.114	.114	Formula $\frac{2}{\text{III-XV}}$
	Segment VI	.105	.105	.105	.114	.114	
	Segment XII-XVI	.324		.324	.324	.341	=1.2 Segment III.
	Total	1.400		1.514	1.487	1.575	
Palpus	Segment I	.027	.027	.022	.025	.027	Formula 1,4,2,3,5.
	Segment II	.077	.077	.076	.081	.076	Relative lengths :
	Segment III	.108	.113	.097	.117	.108	5.2, 16.0, 22.5, 10.0, 28.0
	Segment IV	.048	.054	.045	.050	.045	
	Segment V	.126	.124	.133	.146	.144	
	Total	.386	.395	.373	.419	.400	

Table I. Measurement of male flies

Length in mm. of 5 specimens

	Structure	1	2	3	4	5	Remarks Relative lengths etc. (average of 5 specimens)
Wing	Length	1.740	1.662	1.575	1.662	1.750	3.4 × Breadth
	Breadth	.507	.472	.464	.525	.507	$\frac{\alpha}{\beta}$ = 2.08-2.46
	α	.472	.464	.437	.420	.455	
	β	.192	.219	.201	.192	.219	$\frac{\beta}{\gamma}$ = 1.04-1.24 $\frac{\delta}{\alpha}$ = 0.18-0.33
	γ	.184	.184	.175	.184	.175	$\frac{\alpha}{\gamma}$ = 2.28-2.60 $\frac{\beta}{\xi}$ = 0.30-0.38
	δ	.087	.087	.148	.087	.105	
	ξ	.630	.569	.586	.621	.674	$\frac{\delta}{\xi}$ = 0.67-0.8[illegible] $\frac{\theta}{\xi}$ = 1.32-1.50
	θ	.875	.957	.831	.892	.901	$\frac{\text{Wing length}}{\theta}$ = 1.86-1.99
Hind leg	Femur	.630	.647	.604	.612		Femur = $\frac{1}{6.3}$ length of the leg
	Tibia	1.304	1.266	1.164	1.312		Tibia = $\frac{1}{2.6}$ length of the leg
	Tarsus seg. I.	.831	.814	.787	.849		Tarsus I = $\frac{1}{4}$ length of the leg
	Tarsus seg. II-V.	.744	.787	.682	.726		(not including coxa and trochanter)
	Total	3.509	2.917	3.237	3.499		
Genitalia	Superior clasper (Proximal seg.)	.203	.171	.198	.185	.207	Prox. seg. = 2.0-2.51 distal seg. Prox. seg. = 0.95-1.20 Infer. clasp.
	Superior clasper (Distal seg.)	.090	.084	.079	.066	.082	
	Intermed. appendage	.177	.126		.144	.117	
	Intromittent organ	.108	.108	.100	.108	.090	
	Inferior clasper	.176	.180	.167	.185	.175	
	Submedian lamellae			.108		.103	Submed. lamellae = 0.58-0.64 Infer. clasp.
	Macrochaeta	.086	.077	.081	.063	.081	
	Pompetta & Genital filament	.420	.420	.420	.378	.420	

Table II. Measurement of female flies

~~Length in mm. of 5 specimens~~

	Structure	1	2	3	4	5	Remaks, Relative lengths etc (average of 10 specimens)
Body	Clypeus and Head	.376	.420	.394	.359	.367	
	Thorax	.534	.621	.560	.481	.481	
	Abdomen proper	.958	.997	.805	.849	.700	
	Snperior clasper	.114	.679	.087	.079	.079	
	Total	1.979	2.717	1.846	1.768	1.627	Average 1.87 mm.
Mouth	Labium						
	Pharynx Length	.180	.180				
	Width	.054	.054				
Antenna	Segment III	.254	.262	.271	.236	.236	III>IV+V; IV=V=VI
	Segment IV	.105	.114	.105	.096	.105	III<XII-XVI
	Segment V	.105	.114	.105	.096	.105	Formula $\frac{2}{III-XV}$
	Segment VI	.105	.114	.114	.105	.105	
	Segment XII-XVI	.359	.341	.394	.306	.306	= 1.38×Seg.III
	Total	1.531	1.487	1.575	1.400		= 5.36×Seg.III; 4.16×Seg.XII-XVI
Palpus	Segment I	.034	.027	.027	.027	.040	Formula 1, 4, 2, 5, 3.
	Segment II	.099	.090	.072	.094	.095	Relative lengths :
	Segment III	.117	.144	.126	.135	.129	5.8 ; 17.8 ; 25.4 ; 10.0 ; 19.8
	Segment IV	.058	.063	.036	.054	.050	
	Segment V	.099	.081	.072	.188	.108	
	Total	.407	.405	.333	.498	.422	= 0.21-0.27×antenna

Table II. Measurement of female flies

Length in mm. of 5 specimens

	Structure	1	2	3	4	5	Remarks, Relative lengths etc. (average of 10 specimens)
Wing	Length	1.967	2.066	1.837	1.750	1.750	3.38 × Breadth
	Breadth	.525	.612	.569	.481	.569	$\frac{\alpha}{\beta}=1.74-2.33$
	α	.551	.612	.525	.481	.481	
	β	.262	.262	.245	.236	.236	$\frac{\beta}{\gamma}=1.00-1.48$ $\frac{\delta}{\alpha}=0.24-0.30$
	γ	.219	.262	.210	.192	.130	$\frac{\alpha}{\gamma}=2.50-4.37$ $\frac{\beta}{\varepsilon}=0.32-0.41$
	δ	.131	.149	.131		.131	$\frac{\alpha}{\varepsilon}=0.60-0.76$ $\frac{\theta}{\varepsilon}=1.27-1.48$
	ε	.744	.805	.708	.656	.700	
	θ	1.006	1.111	.989	.945	.945	$\frac{\text{wing length}}{\theta}=1.86-2.00$
Hind leg	Femur	.735	.831	.761	.656	.674	Femur $=\frac{1}{4.9}$ length of the leg
	Tibia	1.365	1.531	1.347	1.251	1.242	Tibia $=\frac{1}{2.6}$ length of the leg
	Tarsus segment I	.857	.980	.849	.849	.805	
	Tarsus segment II–V	.743	.849	.761	.665	.717	Tarsus I $=\frac{1}{4}$ length of the leg
	Total	3.700	4.191	3.718	3.421	3.438	(not including coxa & trochanter)

Explanation of Plates

Plate I.

Figure 1. Wing of Male.

Figure 2. Third and fourth segments of male antenna showing geniculate spines.

Figure 3. Pharyngeal armature of male (greatly magnified)

Figure 4. Male Genitalia showing superior and inferior clasper.

Figure 5. Intermediate appendages with long spines alongside with the intromittent organ.

Plate II.

Figure 1. wing of female.

Figure 2. Pharyngeal armature of female.

Figure 3. Spermathecae.

Figure 4. Palp.

Figure 5. Second, third and fourth segments of female antenna showing geniculate spines.

Figure 6. Fgg of *Phlebotomus hoepplii*.

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（中文提要）

福建白蛉之新種

唐仲璋　　馬駿超

白蛉為一種小形吸血昆蟲。在世界各地，據 Sinton 氏及其他學者之紀錄已達百十餘種。我國之種類，近年來經姚永政吳徵鑑二氏之調查，已知者有七種及一亞種。在我國北部，中華白蛉 *Phlebotomus chinensis* 與蒙古白蛉 *Phlebotomus Sergenti* var. *mongolensis* 曾經證明係為傳佈黑熱病之媒介（Young and Hertig 1926 ; Patton and Hindle 1926, 1928,）。自江蘇省之清江浦以及北平採到之中華白蛉曾有天然感染黑熱病原蟲之發現（Sun, Yao, Chu and Wu 1936 ; Chung and Feng 1939）華南之調查如雲南省有 Gaschen 氏（1934）之報告，江蘇北部之清江浦，南京，廣西，海南島等地姚吳二氏曾經搜集得若干種類。唯東南數省如浙江，江西，福建，廣東，是類昆蟲之報告尚付缺如。

作者等自1943至1945年於建陽邵武永安曾經採集白蛉一種（第一個標本係馬駿超先生在建陽麻沙採得者）。經詳細之研究知係未經科學記載之新種。茲名之為何氏白蛉 *Phlebotomus hoepplii*, Sp. nov. 用以尊崇北平協和醫學校何博禮教授。

本種屬於直立毛類，全體作灰色，其胸部與腹部則略帶淡黃。經詳細之形態研究知與印度安南所產之 *Phlebotomus stantoni* Newstead（=*Phlebotomus maynei* Sinton）最為近似。唯咽喉基部之刺與突起，雄外生殖器之構造，觸鬚之分式，以及翼脈個體背面之長度等，均可資區別。

本文中詳細之形態敘述，以及各部之測量等均依據 Franca 與 Parrot 二氏（1920）及 Sinton 氏（1923）所創之方法。篇末並附有詳表。

何氏白蛉常見於人居住屋內。生殖期大約每年有兩代，第一代出現期為四月至七月。第二代九月至十月。雌蟲關閉在玻璃器內者產卵約三十枚。卵有皺紋，與中華白蛉相似。

廈門浮游矽藻季節的分佈

金　德　祥

The Seasonal Distribution of Planktonic Diatoms of the offshore water of Amoy

by

T. G. Chin

海洋浮游矽藻的分佈，有時間和空間的不同，和海水的變化一樣。但是在大自然的裏面也有一定的法規，可以決定牠的來去和生殺。他們也可以在某種環境之下，特別有利和繁殖，因此就有小蟲，小魚，和下等動物隨着而來，吃這些能够自己製進養料的植物，大洋中的蔬菜，海洋中的魚類，又吃這些小動物，所以有某種矽藻，一定就有某種小動物，和某種食用魚類，換句話說，矽藻就是魚類的線索，我們要研究矽藻季節和地域的分佈，就可以決定有經濟價值的魚類的存在與否。

我們要預測魚期和魚區，必先要有各地過去和現在的記錄，記錄愈久，地域愈多，則推測愈準，所以要完成我們的任務，至少要在十年八年的工夫，在各地研究才行。

關於我國沿海浮游矽藻季節的分佈，過去全無記錄，因爲此種記錄，須繼續不斷的採集，觀察和試驗。不是旅華的西人能做到的。作者於一九三二年用小網採集111次，一九三五年九月至一九三六年八月用大網採集104次，兩年共得215次，平均每星期採集二次，詳細採集的方法，已詳載於拙作（廈門的海產浮游矽藻）一文。

方　　法

個體數目，本文所載每月的數字是八次或九次，採集所得的個體數目或羣體數目的平均數的六百分之一。

溫度：　溫度全採攝氏，空中溫度用普通的溫度計，海底溫度用顛倒溫度計測量，除每次採集時記錄溫度外，1936年在廈門廈門大學海產生物研究場（站）之前，每日記錄一次。

透明度：　用一圓形鐵板，直徑廿厘米，上塗白色瓷漆，懸索垂入海水，以測定深度以厘米計算。

比重和鹽量：　水的樣本，在水面的以普通玻瓶盛裝，在海底的，用Nelson氏錘閉取水瓶取得，比重以海水比重計測定，鹽量1932年以硝酸銀測定，1935—1936年由比重計算而得，廈門研究場（站）前的記錄也放在表內以便比較。

含養量：　1932年採Wrinkler氏法，1935－1936年由廈大前海產生物研究場化學助理研究員黃大炟先生所測，詳黃君報告。

酸度：　（PH value）　用比色盤法測定。

矽和燐也由黃君測定，雨量採廈門廈門大學測候所的記錄。

結　　果

表一　浮游矽藻在度門的季節分佈表（一）

		1932												1935				1936							
		1	2	3	4	5	6	7	8	9	10	11	12	9	10	11	12	1	2	3	4	5	6	7	8
1	*Melosira arctica*			170				10																	
2	*Melosira moniliformis*	1	119	1	4		1	1	1	1								1	26	46	27	1			
3	*Melosira granulata*													58	3	27	27	3	1	9	13	3	33	121	
4	*Melosira juergensi*			20	4								1										1		
5	*Paralia sulcota*	1	1		1	2		1		1		1	1	3		4	1	10	13	8	2	7	12		
6	*Hyalodiscus subtilis*			1		1		1																	
7	*Coscinodiscus excentricus*																		1						
8	*Coscinodiscus lineatus*	1	1			1					2	1	1	8	2		1	9		2		7	10	160	80
9	*Coscinodiscus curvatulus*																22	1					2		
10	*Coscinodiscus janischii*	1												3			1		2						
11	*Coscinodiscus asteromphalus*	47	3	30	5	13	11	16	53	21	48	55	43	480	240	200	242	762	674	778	1066	689	298	594	1283
12	*Planktoniella sol*	1					2	1			3	1		7		1	1	12	1	1				24	24
13	*Actinoptychus undulatus*							1										10							
14	*Actinoptychus anulatar*																	2	1	1					2
15	*Actinoptychus robustus*													3	4	2							3		
16	*Cyclotella occellato*																	1							
17	*Cyclotella comto*																	1							
18	*Cyclotella striata*	2			5	2					2		1							6	1		23		

表一 浮游矽藻在廈門的季節分佈表(二)

		1932												1935				1936							
		1	2	3	4	5	6	7	8	9	10	11	12	9	10	11	12	1	2	3	4	5	6	7	8
19	*Thalaasiosira rotulo*	[illegible]												1				103		16		1			90
20	*Schroderella delicatula*																						1		
21	*Skeletonema costotum*	42		3	4	1	1	1	22		22			513	20	21	2	13		2		3	3	450	1309
22	*Stephanopyxis palmecioa*		1					7		4	1			5				1	4	6	4	7	4	300	48[illegible]
23	*Corethron hystrix*					1		2			1			13				34	4			5	7		
24	*Corethron pelagicum*	2				1		3		2	1			23	1	1	3	6	3	4	4	3	16	220	92
25	*Bacteriastrum hyalinum*	12				13	1	19		6	1			26	3		1			1		8	26		1093
26	*Bacteriastrum delicatulus*																						4		6
27	*Rhizosolenia fragillissima*	[illegible]					1		1	1	1	1	1					14	8			4			
28	*Rhizosolenia stolterfarthii*					2		2			2		1	32	1			2							
29	*Rhizosolenia alata*	3			1	4					1			3									1		
30	*Rhizosolenia robusta*									1				2	1				1			4	72	795	56
31	*Rhizosolenia acuminata*					1								1											
32	*Rhizosolenia imbricata v. schubsolii*	1				1	1			1	1	1	51	4				25	11			3	30		
33	*Rhizosolenia setigera*	1			18	5		5			1	1						1			1	32	8		
34	*Rhizosolenia styliformis*	1				15		1			2		3	7			20	8	2		2	17			
35	*Rhizosolenia calcar avis*					1			2				2	1								8	32		
36	*Chaetoceros peruvianus*	4					3	4		1										1					

表一 浮游矽藻在廈門的季節分佈表(三)

		1932												1935				1936							
		1	2	3	4	5	6	7	8	9	10	11	12	9	10	11	12	1	2	3	4	5	6	7	8
37	*Chaetoceros coarctatus*					13	1	2	3					6	1		1					27	25		574
38	*Chaetoceros borealis*	2					1	11				1		73		2									
39	*Chaetoceros eibenii*																	1							
40	*Chaetoceros subtilis*					1		1																	
41	*Chaetoceros affinis*																							1	
42	*Chaetoceros didymus*																							1	
43	*Chaetoceros decipiens*	32				16	1	5	16	5	23	1		106	3	4	16	6		1		1	77	140	635
44	*Biddulphia pulchella*	1	94	1	1			8		1										3	3	10			
45	*Biddulphia laevis*																		15						
46	*Biddulphia sinensis*	12	3	22	3	15	1	3	2	6	11	1	11	59	9	8	17	1014	536	116	212	284	990	836	927
47	*Biddulphia granulata*							6														2			
48	*Biddulphia mobiliensis*													3									2		
49	*Biddulphia aurita*							1										88	2	3					
50	*Triceratium favus*												1	2				152	1			1			
51	*Bellerochea malleus*	3																							
52	*Hemiaulus hauckii*													9							3				
53	*Hemiaulus chinensis*							1						23									24		
54	*Cerataulina bergonii*	1				1		10		2			1	21	8							1	20	110	

表一 浮游矽藻在廈門的季節分佈表(四)

		1932												1935				1936							
		1	2	3	4	5	6	7	8	9	10	11	12	9	10	11	12	1	2	3	4	5	6	7	8
55	*Ditylium brightwellii*	23	2			5	8		11	3	58	5	4	19	9	4	1	120	83	2		1	16		473
56	*Ditylium sol*	1																12	2						
57	*Eucampia zoodiacus*	1		1		19	6	2			7		1	11				8	4		8	14	21	16	193
58	*Climacodium frauenfeldianum*													1	1	1	1								
59	*Fragilaria crotonensis*			7	4				1				1											4	
60	*Fragilaria striatula*			3				1																	
61	*Synedra gallionii*																								
62	*Astorronella japonica*													65	1										32
63	*Asterronella kariana*																	116	2	2					
64	*Asterronella formosa*				1							1													
65	*Thalassiothrix longissima*	1	1	1			1	1	1	1	1	1	1	1	1	1	1	1	1		1			1	1
66	*Thalassiothrix frauenfeldii*	48				1	7	7	43	34	10	2	1	274	29	3	4	4	2			3	15	32	1579
67	*Thalassiothrix nitzschioides*	5	1	1		5	7	1	9	52	8		1		4	3	1	17	4		2	11	16	24	312
68	*Gramatophora marina*			6																				18	
69	*Gramatophora undulata*																			10					
70	*Licmophora abbreviata*		2	3	216																				
71	*Climacosphenia moniligera*				1																				
72	*Achnanthes brevipes*		1		58	1															1				

表一 浮游矽藻在廈門的季節分佈表(五)

		1932												1935				1936							
		1	2	3	4	5	6	7	8	9	10	11	12	9	10	11	12	1	2	3	4	5	6	7	8
73	*Cocconeis scutellum*																						1		
74	*Navicula directa*																	1							
75	*Navicula cancellata*	1	2							1			1				22	1	3			1			
76	*Gyrosigma balticum*	1		1	5					2					2										
77	*Pleurosigma formosum*	1	1	2	7	3	1	1	5	1	3	2	1		1			1	2	2	2	6			
78	*Amphora costata*					1																			
79	*Bacillaria paradoxa*	1		1		1	2	2	2	1	6			21	6		1	1	1			8	11		970
80	*Nitzschia longissima*			1	1	1	1			1															
81	*Nitzschia seriata*	11				1	4				1														
82	*Surirella voigtii*	1				1					1	1						1	1				50		

表二　厦門主要浮游矽藻的季節分佈表

		1932												1935				1936							
		1	2	3	4	5	6	7	8	9	10	11	12	9	10	11	12	1	2	3	4	5	6	7	8
1	*Melosia moniliformis*	1	118	1	4		1	1	1	1				53	3	27	27	1	26	46	27	1	33	151	
2	*Coscinodiscus asteromphalus*	47	3	30	5	17	11	16	53	21	46	55	43	480	240	200	242	762	673	778	1066	687	296	594	1277
3	*Skeletomema costatum*	42		3	4	1	1	1	22		22			513	20	21	2	13		2		3	3	450	1000
4	*Bacteriastrum hyalinum*	12				13	1	19		6	1			26	3		1			1		3	36		1003
5	*Rhizosolenia robusta*									1				2	1				1			4	72	795	56
6	*Chaetoceros decipiens*	32				16	1	5	16	5	23	1		106	3	4	16	6		1		1	77	140	633
7	*Biddulphia sinensis*	12	3	22	3	15	1	3	2	6	11	1	11	59	9	8	7	1014	537	1166	212	284	990	830	927
8	*Ditylium brightwellii*	23	2			5	8		11	3	58	5	4	19	9	4	1	120	83	2		1	16		473
9	*Thalassiothrix longissima*	1	1	1			1	1	1	1	1	1	1	1	1	1	1	1	1		1			1	1
10	*Thalassiothrix frauenfeldaii*	48				1	7	7	43	34	10	2	1	274	20	3	4	4	2			3	15	320	4579
11	*Thalassiothrix nitzchioides*	5	1	1		5	7	1	9	52	8		1		4	3	1	17	4		2	11	16	24	312
12	*Pleuresigma formosum*	1	1	2	7	3	1	1	5	1	3	2	1		1			1	2	2	2	6			
13	*Bacillaria paradoxa*	1		1		1	2	2	2	1	6			21	6		1	1	1			8	15		970
14	個體種數	225	130	61	24	73	42	57	165	132	191	67	62	1554	320	271	213	1940	1330	1998	1310	1017	1071	2231	11638
15	平均種數	12	7	8	5	10	12	11	11	12	11	7	7	11	13	9	11	11	11	8	6	12	11	9	11

表三 廈門海水的物理化學按月平均的記錄表

	年度	正月	二月	三月	四月	五月	六月	七月	八月	九月	十月	十一月	十二月	平均
氣溫	1932.	16.9	13.3	17.8	19.7	[illegible]	29.6	32.1	31.3	29.0	27.0	24.4	21.0	24.2 °C.
	1935.—36	1936 13.3	12.7	11.9	18.3	21.9	26.6	27.8	28.2	1935 28.1	29.5	22.8	16.4	21.4 °C.
	1936.(站)	16.1	14.8	12.8	18.3	26.1	26.8	29.3	29.2	28.1	27.5	22.0	18.7	22.5 °C.
	平均	15.4	13.6	14.2	18.8	25.4	27.7	29.7	29.6	28.4	28.0	23.7	18.7	22.8 °C.
表面水溫	1932.	13.7	14.8	14.5	17.5	[illegible]	27.6	29.2	28.9	25.9	25.9	23.2	17.6	22.1 °C.
	1935.—36.	13.3	12.7	11.5	15.8	[illegible]	25.5	26.9	27.4	26.6	25.9	22.3	17.1	20.5 °C.
	1936.(站)	14.5	13.9	11.9	16.2	[illegible]	26.3	25.4	28.8	26.9	25.9	20.4	20.9	21.6 °C.
	平均	13.8	13.8	12.6	16.5	[illegible]	26.5	28.2	28.4	26.5	25.9	22.0	18.5	21.4 °C.
水底水溫	1935.—36.	14.5	13.[illegible]	11.9	16.3	22.2	25.6	27.6	29.9	26.2	26.[illegible]	22.5	14.8	29.9 °C.
透明度	1935.—36.	159.8	[illegible]	96.8	94.[illegible]	96.5	170.2	167.7	127.1	144.8	91.[illegible]	99.1	104.2	118.0 Cm.
雨量	1932.	0	31	113	192	14[illegible]	226	155	174	123	0	18	45	101.9 mm.
	1935.—36.	17.4	196.6	95.1	93.9	[illegible]	66.1	118.[illegible]	61.1	99.6	14.0	0.1	10.8	80.3 mm.
	平均	8.7	113.8	104.0	143.0	167.6	146.0	137.0	117.6	111.5	7.0	9.1	27.9	91.8 mm.
水面比重	1935.—36.	1.0[illegible]	1.019[illegible]	1.0172	1.0171	1.017[illegible]	1.0178	1.0212	1.0177	1.0188	1.0227	1.020[illegible]	1.0193	1.0190
	1936.(站)	1.0165	1.019[illegible]	1.0173	1.019[illegible]	1.016[illegible]	1.0175	1.0207	1.0183	1.0191	1.022[illegible]	1.0214	1.0216	1.0193
	平均	1.01[illegible]	1.0[illegible]	1.0173	1.0[illegible]	1.01[illegible]	1.017[illegible]	1.0210	1.0160	1.0189	1.0224	1.0208	1.0205	1.0190
水底比重	1935.—36.	1.016	1.019[illegible]	1.0188	1.01[illegible]	[illegible]	1.020[illegible]	1.0223	1.0203	1.0229	1.0247	1.0216	1.0194	1.02[illegible]
水面含鹽量	1932.	27.8	28.[illegible]	27.4	23.7	20.1	24.8	28.[illegible]	27.7	25.7	27.8	28.3	27.7	27.2%
	1935.—36.	[illegible]	27.0	23.6	[illegible]	[illegible]	24.2	[illegible]	23.7	25.7	30.[illegible]	27.3	26.3	[illegible]%
	1936.(站)	26.[illegible]	27.[illegible]	2[illegible]	25.9	[illegible]	[illegible]	28.[illegible]	25.0	26.0	29.9	29.0	29.8	2[illegible]%
	平均	26.[illegible]	27.[illegible]	24.9	25.9	[illegible]	24.1	2[illegible].4	25.5	25.8	29.5	28.2	27.8	26.4%
含氧量	1932.	6.29	5.0[illegible]	5.8[illegible]	5.8[illegible]	4.7[illegible]	3.82	3.9[illegible]	4.2[illegible]	4.59	5.25	5.60	5.82	5.19mg/l
鹼度	1932.	8.40	8.[illegible]	8.3[illegible]	8.40	[illegible]	8.46	8.4[illegible]	8.40	8.36	8.40	8.36	8.40	8.39
矽質量	1935.—36.	2.6[illegible]	1.3[illegible]	2.51	2.12[illegible]	2.[illegible]	2.225	1.58[illegible]	1.750	2.000	2.000	2.[illegible]70	2.917	2.[illegible]2p.p.m.
含燐量	1935.—36.	0.0[illegible]5	0.0[illegible]	0.078	0.072	0.0[illegible]	0.081	0.052	0.05[illegible]	0.070	0.076	0.030	0.087	0.075p.p.m.

討　論

兩年採集共得浮游矽藻八十二種，四十屬。其中有十二種是廈門常有的主要矽藻，尤其以 Coscinodiscus asteromphalus，和 Biddulphia sinensis 爲最重要，詳下表：

表四　主要浮游矽藻個體數目和月數分配表

		一月內所採個體平均數目在三十萬以上	二年內所採個體數目平均在二萬五千以上	二年中有十八個月以上採到的	二十四個月都採到的	備　註
1	*Melosira moniliformus*			×		
2	*Coscinodiscus asteriomphalus*	×(一百以上)	×廿萬以上)	×	×	
3	*Skeletonema costatum*	×	×	×		
4	*Bacteriastrum halimum*	×	×			
5	*Rhizosolenia robusta*	×				
6	*Chaetoceros decipiens*	×	×	×		
7	*Biddulphia sinensis*	×	×	×	×	
8	*Ditylium brightwellii*			×		
9	*Thalassiothrix longissima*			×		數量極少
10	*Thalassiothrix frauenfeldii*	×(一百以上)	×	×		
11	*Thalassiothrix nitzchioides*			×		
12	*Pleurosigma formosum*			×		數量極少
13	*Bacillaria paradoxa*		×			
	總　計	七　種	七　種	十　種	二種	

兩年內只採到一二次的有二十六種，十八次以上的有十種，分配如下表：

表五　矽藻種數在二年內採到的次數（以月計）分配表

月數	次數	月數	次數	月數	次數	月數	次數
1	15	7	3	13	3	19	3
2	11	8	3	—	—	20	2
3	7	9	3	15	2	—	—
4	9	10	2	16	1	—	—
5	5	11	1	17	2	—	—
6	4	12	1	18	3	24	2

廈門海中的浮游矽藻，屬海生的有七十八種，其餘四種是由淡水流入海中的海產的又可分做三類，遠洋性的有二十三種，近海性的有四十二種，脫離附着物而浮游於水中的有十六種遠洋與近海性的裏面，又可分爲寒帶溫帶和熱帶的主要矽藻，寒帶性的有九種，熱帶性的有八種，其餘四十八種是屬於溫帶的，內中 *Chaetoceros peruvianus* 在溫帶熱帶都是主要的浮游矽藻，所以在表內遇到兩次，*Rhizosolenia imbricati V. schubsolii* 遇到三次，詳表六。

以屬別而論，廈門浮游矽藻中，Rhizosolenia有九種，Chaetoceros有八種，Biddulphia有六種，Coscinodiscus有五種，其餘種數較少。以全年而論，Melosira，Coscinodiscus，skeletonema，Corethron，Biddulphia，Tnalassathrix 和 Pleurosifma 七屬，終年都有。詳表七。

廈門浮游矽藻，除 Climascophenia 只採到一次，和底生的 Cyctotella 兩屬之外，十一屬在日本，Jara，Puget Samd，Woods Hole；Marine，Nesdishes Plankton，和 Nosthern Seas七處都有。Synedr Cocconeis，Gyroingma，和 Amphora 四屬與各地相同的記載，只有一次，其餘各屬或有或無，如以百分比而論，廈門各屬的矽藻，百分之五十以上，百分之八十五以下是相同的。上列各地的66%，67%以上，到百百分之八十五以下，在廈門也有。因爲浮游矽藻是隨海水來去的。詳表八。

以全部矽藻的數量而論，十一月常爲最低，十二月卽漸高漲，翌年正月達一頂點，二月又降，三四月間又漲，五六月同下，八九月又起，十月又降，一年內共有三次的高升，冬（正月）、春、秋三季，各有一次，隨後下降。以種數而論，一年之內也有三次的升降，和數量的多少相符。一九三二年五月種數減少，和溫度的多少有關，六月種數未減而數量突然下降，是否當時海中某種養料的缺乏，不得而知，因爲當時海水沒有化學方面的記錄，無從解釋。一九三六年七八兩月種數少，而總量極多，因爲廈門主要浮游矽藻驟增的緣故。

一九三二年和一九三五年、三六年的曲線似有不同，1932年爲最高在四月，而一九三五、三六年在八九月。如把一九三二年四月脫離附着物而成，浮游的矽藻 Liemophora abbreviata 除去後，兩曲線就會完全相符，最高期都在秋季。因爲經過高溫的夏季以後，矽藻的數目大增，海中的矽質和鐵質因矽藻的增加而減少，與含養量和溫度，透明度和海水的混濁有關係，與浮游生物

量的多少，無明顯的表示，海水的其他物理化學性質只能作七種記載而已，和浮游生物生殺的關係，尚不能作詳細的解釋，待多年的記載後再來說明。

結　論

1. 1932年，1935九月至1936年八月，兩年內，共採樣本二百十五次，發現八十二種，屬於四十屬，其中主要的有十三種，計 Melosira moniliformis, Coscinodiscus asteriomphalus, Skeletronma costatum, Bacteriestrum hyalinum, Rhizosolenia robusta, Choetoceros decipiens, Biddulphia sinensis, Ditylium brightwellii, Thelassiothrix longissima, Thalassiothrix frauenfeldii, Thalassiothrix nitzchioides, Pleuresigma formasum, 和Bacillaria paradoxa, 一年內量的最高點計有三次，正月，三四月，和八九月，而以八九月為最高。
2. 八十二種矽藻內屬遠洋性的計二十三種，近海性的四十二種，附着海底的十六種，淡水的四種。
3. 各層矽藻的半數以上，世界各國也有。
4. 海洋的物理化學變化，詳列於表三。

表六　矽藻分佈表

遠洋性的

寒帶

Hyalodiscus subtilis, Rhizosolenia imbricata V. schubsolli, Chaetoceros borealis,
Chaetoceros decipiens, Thalassiothrix longissima, Nitzschia seriata,

溫帶

Bacteriastrum helicotulus, Rhizosolenia alata, Rhizosolenia acuminata,
Rhizosolenia styliformis, Chaetoceros peruvianus, Ditylium sol,
Coscinodiscus excentricus, Coscinodiscus lineatus, Coscinodiscus curvatulus,
Coscinobiscus janischii, Coacinodiscus asteromphalus, Asteromphalus robustus,
Corethron hystrix, Thalassiothrix frauenfeldii,

熱帶

Planktoniella sol, Chaetoceros Peruvianus, Chaetoceros coarctatus,

近海性的

寒帶

Melosirca arctia, Biddulphia aurita, Navicula directca,

溫 帶

Actinoptychus	anulatus,	Cyclotelia	striata,	Thalassiosira	rotula,
Skeletonema	costatum,	Stephanopyxis	palmerina,	Corethron	pelagicum,
Bacteriastrum	hyalinum,	Rhizosolenia	frogillissima,	Rhizosolenia	stolterforthii,
Rhizosolenia	robusta,	Rhizosolenia	imbricata V.	schubslii,	
Rhizosolecia	setigera,	Rhizosolenia	calcor avis,	Chaetoceros	eibenii,
Chaetoceros	subtilis,	Chaeioceres	affinis,	Frogilaria	striatula,
Synedra	gallionii,	Asterionella	japonica,	Asterionella	kariana,
Thalassiothrix	fitzschioides,	Grammatophora	marina,	Grammatophora	undulata,
Bacillaria	paradoxa,	Nitzschia	longissima,	Chaetoceros	didymus,
Biddulphia	pulchella,	Biddulphia	mobiliensis,	Hemiaulus	hauckii,
Ceratoulina	Bergonii,	Ditylium	brightwellii,	Eucampia	zoodiacus,
Climacodium	frauenfeldianum,	Frogilaria	crotonensis,		

熱 帶

Schroderella	delicatula,	Rhizosolenia	imbricatav,	schubsolii,	
Biddulphia	sinensis,	Bellerochea	malleus,	Hemiaulus	chinensis,

脫離附着物而浮游的

Melosira	moniliformis,	Melosira	juergensi,	Patalia	sulcata,
Actinoptychus	undulatus,	Biddulphia	laevis,	Biddulphia	granulata,
Thiceratium	fovus,	Licmophora	addreviata,	Climacosphenia	moniligera,
Achnanthes	brevipes,	Cocconeis	scutellum,	Navicula	cancellata,
Gyrosigma	balticum,	Pleurosigma	formosum,	Amphora	costata,
Surirella	voigtii,				

淡 水 的

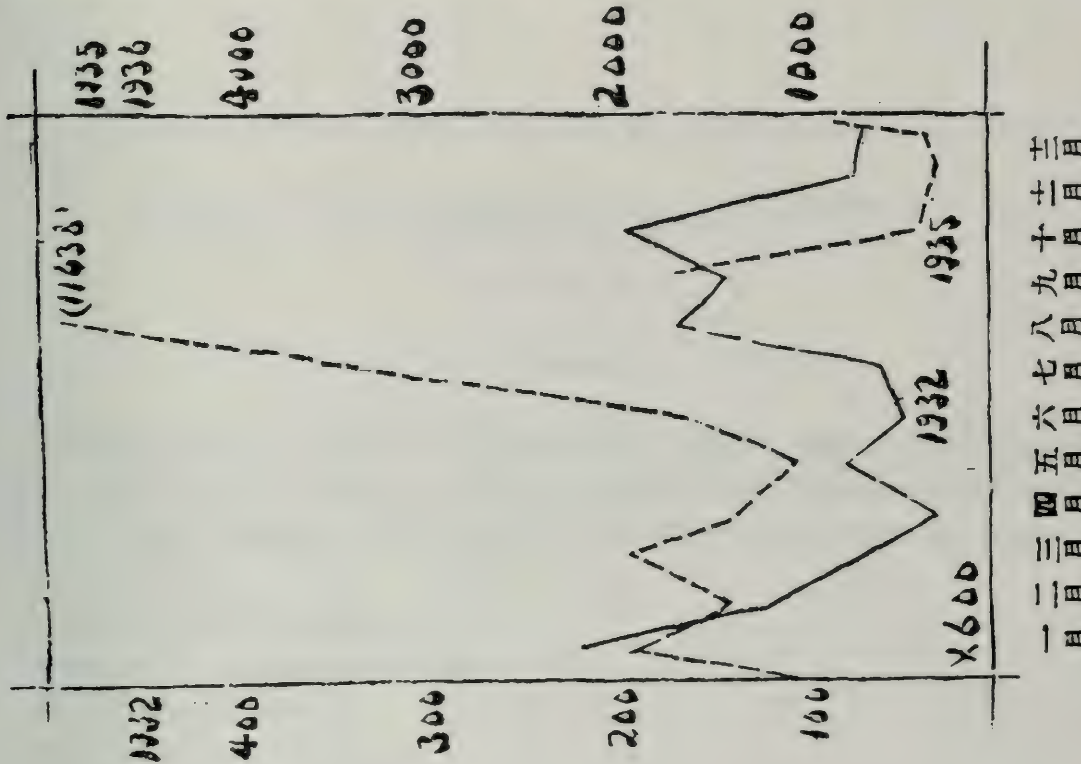
Melosira	granulata,	Cyclotllla	occellata,	Cyclotella	comta,
Asterionella	formosa,				

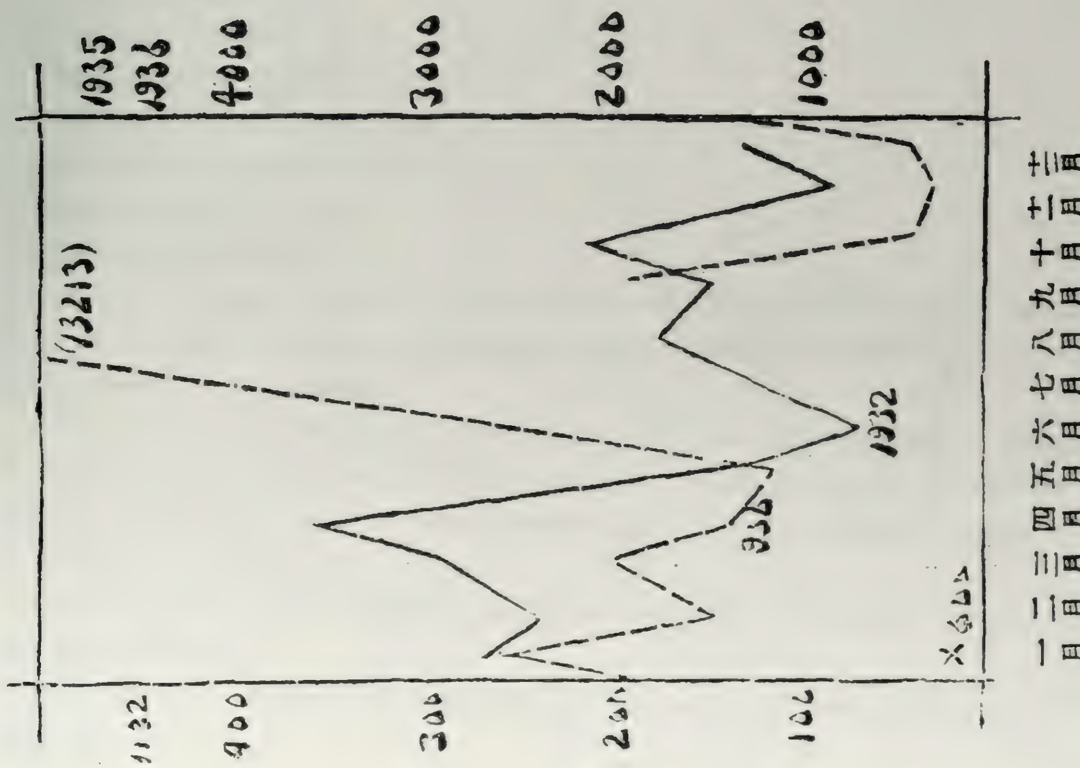
表七　各屬矽藻的季節分佈

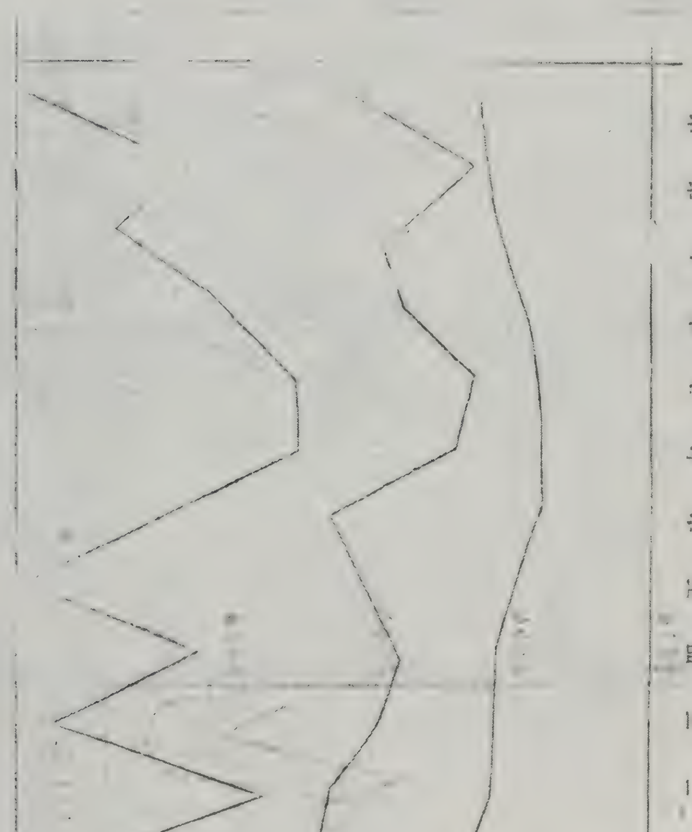
		正月	二月	三月	四月	五月	六月	七月	八月	九月	十月	十一月	十二月	種數
1	Melosira	2	2	4	3	2	3	3	1	2	1	1	2	4
2	Paralia	1	1	1	1	1	1	1		1		1	1	1
3	Hyalodiscus			1		1		1						1
4	Coseinodiscus	4	4	2	1	2	3	2	2	3	3	2	4	5
5	Planktoniella	1	1	1		1	1	1	1	1	1	1	1	1
6	Actinoptychus	2	1	1			0	1	1					2
7	Asteromphalus						1			1	1	1		1
8	Cyclotella	3		1	1	1	1				1		1	3
9	Thassiosira	1		1		1			1	1				1
10	Schroderella						1						2	1
11	Skeletonema	1	1	1	1	1	1	1	1	1	1	1	1	1
12	Stephanopyxis	1	1	1	1	1	1	1	1	1	1			1
13	Corethron	2	2	1	1	2	2	2	1	2	2	1	1	2
14	Bacteriastrum	1		1		1	2	1	2	1	1		1	2
15	Rhizosolenia	6	4		3	9	6	3	3	8	7	3	5	9
16	Chaetoceros	4		2		3	4	7	2	4	2	2	2	8
17	Biddulphia	3	4	3	2	3	2	4	1	3	1	1	1	6
18	Triceratium	1				1				1			1	1
19	Bellarochea	1												1
20	Hemiaulus				1		1	1		2				2
21	Cerataulina	1				1	1	1		1	1		1	1
22	Ditylum	2	2	1		1	1		1	1	1	1	1	2
23	Eucampia	1	1	1	1	1	1	1	1	1	1		1	1
24	Climacodium									1	1	1	1	1
25	Fragilaria			2	1			2	1				1	2
26	Synedra	1												1
27	Asterionella	1	1	1	1				1	1	1	1		3
28	Thalassiothrix	3	3	2	2	2	3	3	3	3	3	3	3	3
29	Grammatophora			2				1						2
30	Licmophora		1	1	1									1
31	Climascophenia				1									1
32	Achnanthes		1		1	1								1
33	Cocconeis						1							1
34	Navicula	2	1			1				1			1	2
35	Gyrosigma	1		1	1					1				1
36	Pleurogigma	1	1	1	1	1	1	1	1	1	1	1	1	1
37	Amphora					1								1
38	Bacillaria	1	1	1		1	1	1	1	1	1		1	1
39	Nitzschia	1		1	1	2	2			1	2			2
40	Surirella	1	1			1	1					1		1
	No. of Genera	28	21	25	20	25	24	21	19	26	21	16	21	40

表八 廈門各屬浮遊矽藻在各地的分佈

		日本	Java	Puget Sound	Woods Hole	Maine	Nordisches Planktons	Northern Seas	
1	Melosira	×		×	×	×	×	×	6
2	Paralia	×	×	×	×	×	×	×	7
3	Hyalodiscus			×	×		×	×	4
4	Coscmodiscus	×	×	×		×	×	×	6
5	Plankt oniella	×	×	×			×	×	5
6	Actinoptychus	×	×	×	×	×	×	×	7
7	Asteramphalus	×	×	×			×	×	5
8	Cyclotelia								0
9	Thalassiosira	×		×	×	×	×	×	6
10	Schraderella		×					×	2
11	Skeletonema	×	×	×	×	×	×	×	7
12	Stephanopyxis	×	×	×	×		×	×	6
13	Corethron	×	×	×	×	×	×	×	7
14	Bacteriastrum	×	×	×	×		×	×	6
15	Rhizosolenia	×	×	×	×	×	×	×	7
16	Chaetoceros	×	×	×	×	×	×	×	7
17	Biddulphia	×	×	×	×	×	×	×	7
18	Triceratium	×					×	×	3
19	Bellarochea		×		×		×	×	4
20	Hemiaulus	×	×				×	×	4
21	Cerataulina	×	×				×	×	5
22	Ditylium	×	×	×	×	×	×	×	7
23	Eucampia	×	×	×		×	×	×	6
24	Cliniacodium	×	×				×	×	4
25	Fragilaria	×		×	×	×	×	×	6
26	Synedra				×				1
27	Asterionella	×	×	×	×	×	×	×	7
28	Thalassiothrix	×	×	×	×	×	×	×	7
29	Gramm atophora				×			×	2
30	Licmophora		×		×	×	×	×	5
31	Climascophenia								0
32	Achnanthes	×				×	×	×	4
33	Cocconeis	×							1
34	Navicula	×	×	×		×	×	×	6
35	Gyrosigma							×	1
36	Pleurogigma	×	×	×		×			4
37	Amphora		×						1
38	Bacillaria		×	×			×	×	4
39	Nitzschia	×	×	×	×	×	×	×	7
40	Surirella	×	×					×	3
	共計屬數和廈門記載相同	29	28	25	21	20	30	34	
	比 例 %	72.50	70.00	62.50	50.25	50.00	75.00	85.00	66.46
	各地記載屬數的總數	37	42	33	25	30	44	51	
	比 例 %	78.38	63.67	73.76	84.00	66.67	68.18	66.67	72.23%


1935
1936
4000
3000
2000
1000
(11638)
1935
1932
×600
1932
400
300
200
100
一月 二月 三月 四月 五月 六月 七月 八月 九月 十月 十一月 十二月


1935
1936
4000
3000
2000
1000
(13213)
1932
1932
400
300
200
100
一月 二月 三月 四月 五月 六月 七月 八月 九月 十月 十一月 十二月


一月
二月
三月
四月
五月
六月
七月
八月
九月
十月
十一月
十二月

The Seasonal Distribution of Planktonic Ciatoms of the offshore waters of Amoy

by Chin T. G.

(Summary)

During the year 1932 and from Septembet of 1935 to August of 1938, two hundred fifteen samplings were made and eighty two species of planktonic diatoms belonging to forty two genera were collected. Among them the following thirteen species are the most important:

Melosira moniliformis
Coscinodiscus astertomphalus
Skeletonema costatum
Bacteriastrium hyalinum
Rhizosolenia robusta
Chaetoceros decipiens
Biddulphia sinensis
Ditylium brightwelii
Thalasstothrix longissima
Thalassiothrix frauenfeldii
Thalassiothrix nitzchioides
Pleurosigma formosum
Bacillaria paradoxa

The highest rate of seasonal distribution occurs three times in a year, namely, (1) January, (2) March and April (3) August and September. Of these three seasons the highest peak is in the autumn.

Of the eighty two species of diatoms there are twenty three species of pelagic forms and forty two species of near-sea forms, sixteen species occurring at the sea bottom and four species which are of the fresh-water origin and have been washed in to the sea by the river current.

More than half of the diatoms collected in the present study also occur in other parts of the world.

The physical and chemical conditions of the sea water near Amoy are recorded in Table III.

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蠅類食物習性之分析及其孳生處所之鑑別

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Analysis of the Fly's feeding Habits and the Discrimitation of its Breeding Places

by Huang-Chen

一、前　言

蒼蠅之孳生與多數疫病之流行有不可分離的關係，這是盡人皆知的事實。霍瓦特（Howard）說：「傷寒症之傳播，完全由於蒼蠅之媒染」。他把家蠅（*Musca domostica*）稱之為傷寒蠅（Typhoid fly）。巴爾(Bahr)研究赤痢病之傳染，則謂蒼蠅為赤痢之源泉，他調查過蘇味(Suvia)地方的痢疾，只在十一月至四月之間發生，菲記島（Fiji）製糖廠附近，則全年皆見流行。推究原因，蘇味的天氣自十一月至四月間，比較暖和，在這時候蒼蠅蕃殖最盛；菲記島製糖廠附近地方，則一年到頭蒼蠅都可以從糖屑中發生出來。格來各（Greig）調查印度普牙利（Puri）之霍亂症，證明霍亂之流行，完全由於蒼蠅之傳播，他不但發見了蒼蠅身體表面的多量霍亂病源菌，而且在蒼蠅的消化器中，還發見了許多可以傳染疫病的霍亂細菌。鐵彪脫（Tebbutt）等在蠅蛆體內，發見了副傷寒桿菌（Paratyphoeus. A），高時烏（Gorsio）等發見鼠疫桿菌（*Pasteurella-Pestis*），格拉罕（Graham smirh）等發見炭疽桿菌（*Bactoria anthracis*），勒丁罕（Ledingham）等發見綠膿桿菌（*Psendomonas Pyocyanea*），他們做過種種實驗，證明了這些病源細菌，都能够在蠅蛆體內作較長時間之潛伏，待其羽化之後，再隨蠅糞而傳播疾病於人體。烏魯門（Wollman）除證實了成蠅傳染傷寒、霍亂、痢疾、及上述諸病之外，且在蒼蠅體上，發見了結核桿菌（*Mycobaclerium luberculosis*），流產桿菌（*Bacillus abotus*），米利他熱球菌（*Micrococcas militenes*），因此認為蒼蠅與癆病、流產、和米利他熱症，亦有關係。近世醫生應用種種科學方法，證明白喉、癲病、痘瘡、瘤腫及脾脫疽，亦大都由蒼蠅所媒染。美國科學家魯特(Root)更進而實驗蒼蠅對於病源原生動物及內臟寄生蟲（如肝蛭、蛔蟲鞭蟲等）卵和胞囊之散播，亦為重要媒介。可見凡屬可以傳染的疾病，都藉蠅類以散播、流行，牠所給與人類生活上痛苦之深劇和經濟上損失之巨大，絕不是洪水猛獸之害所可比擬；即就戰爭上最使人害怕

的尚慣人厭而已，其摧殘之慘烈，實際上亦遠不若蒼蠅之嚴重。無怪乎談虎色變，只要稍稍懂得衛生的人，每看到了蒼蠅的影子，立刻就會聯想到那成千成萬死於疾病的蠅害問題上去，把他嚇得發抖。不過一般人對於蒼蠅（Ely）這一名詞的觀念，還嫌過於含糊，而所指的蒼蠅之範圍，又未免太過廣泛了。雖然沒有包括整個雙翅目（*Diptera*）的昆蟲在內，但至少也指着雙翅目環裂亞目（*Cyclorapha*）裏好幾科的昆蟲而說的。其實蠅類中也有不少種屬，對於人生是有益的：比方食蚜蠅科（*Syrphidae*）裏面有許多種的幼蟲專食蚜蟲，可以為人們保護作物和果樹；大毛蠅（*Servillia luteollacoq*）黑毛蠅（*Gonia picea Mats*）等寄生性的蠅類，它的幼蟲大都寄生在蝶蛾幼蟲體內，也直接為農家殲除了害蟲。其他像眼蠅（*Conops curtuluscoq*）花蠅（*Eristalis tenax L*）之類，為的要在花間採蜜，無意中替作物和花卉傳播花粉，促進作物和花卉結實、傳種，當然也與人生有很大的利益。即就腐食性（Sepsid）的蠅類而說，雖然牠們大多數都喜歡趨腥逐臭，生活在各種污穢的腐物或糞便中，易於傳播病菌為害人畜，然其食物習性，並不完全一樣；牠們的孳殖處所亦各有不同。最顯而易見的，如青蠅（*Chrysomyia megacephala*）喜食人糞，孳殖於糞坑中，便為痢疾、霍亂、傷寒等疫症的主要媒介；飯蠅（*Homalomyia canicularis L*）喜聞飯香，吸食飯菜，麕集在膳廳或廚房裏，便與疫病關係比較的少。假使我們能夠把各種蠅的食性和孳殖處所，識別得清清楚楚，再依照其生活史上各時期的特殊習性去誘集而殲殺之，定會收到防疫工作上最高的效果。這樣從根本上去消弭疾病之發生，比之打防疫針，或者增加醫療設備的辦法，實在要好過幾千百倍。作者曾於民國二十六年秋主教生物學科於國立中正醫學院，即在南昌從事（蠅類若干問題之研究，惜因環境變遷，八年來一再易地服務，工作未能順利進行，截至三十年夏季，僅只做到幾種重要蒼蠅地理上分佈之調查，及若干種屬生活史之觀察。迨至三十年秋季，奉命接收省立科學館，籌備動植物研究所於沙縣，因設備之便，乃復從事蠅類食物習性和孳殖習性之觀察。先後實驗四十餘次，捕獲及培養蠅類二十餘種，都萬餘隻，分別記載各種不同食物所誘捕和培養出之蠅類，並計算每種蠅在每一實驗中所佔之百分比與平均數，冀有以明瞭其各別食物習性和孳殖習性，作為衛生上防蠅和滅蠅之參考。

二、　蠅類食物習性之分析

蠅類的食物習性，及以大別為肉食性（Carrivorous）素食性（Herbivorous）和雜食性（Omnivorous）三種。肉食性之蠅類中，有若干種屬，專以吸血為生，別有吸血蠅之稱。其食性互異，消化器的構造，因亦各有不同。為說明之便利計，在未論述其食物習性之前，先把蠅之消化器管略加研討亦殊必要。

（一）蠅類消化器管之結構　昆蟲消化器之主要部分為口器，（Mouth Part）和消化管（Alimentary Canal）。一般口器，殆皆由於上唇（labrum）大顎（Mandible），小顎（Maxilla）下唇（Lablum）和下咽頭（Hypopharynx）所組成。這些部分，有時是正常的構成咀嚼口（Manchibulate type）；有時某一部分稍有變化，構成各樣各式之吸收口（Suktorial type）。蠅類的口器，乃吸收口中變化特別複雜之一種，其上下唇和下咽頭，構成吻管，末端具肥大的唇瓣（Labila），適宜舐食之用。格拉罕（Graham Smith）對此種口器有精密的研究，他把吻管分為三個部分：第一部稱為吻根（Roster），和頭部相連，成圓錐狀；第二部稱為吻柄（Hanstellum），成喇叭狀，與根部互為關接；第三部連接於柄的末端，擴展成吸盤狀物，即前面所說的唇瓣。在牠那由上唇和下唇合成的吻管裏面，藏着針狀的大小顎，以助螫刺；唯一般蠅類的大小顎，大都退化，無

後螯刺的效用。

唇瓣或稱爲匙（Spoom），構造僱極精巧，左右兩半部能自由折疊，像書籍之啓閉一般。其下面（卽折疊時的裏面）開展時成心臟形，上有三十一對橫列的管道，稱擬氣管（Pseudotrachee）。這擬氣管同體內用以呼吸的氣管（Traehea）很相似，舐食時，用唾液從這些管的裂口滲流出來，用以溶解固體食物，使之成爲流質，然後由吻管吸收進去。吻管裏面再加唧筒相似的裝置，食物先吸進吻管裏，再從吻管基部送到口腔管裏去。這吻管平時都是從吻根與吻柄關接處折疊一起，貼放在頭的下面，要等到攝食時，才伸直起來，同時展開唇瓣去舐刺。唇瓣的外面和周圍生長有多數感覺毛，吻柄基部連於下顎處更有一對棍棒狀的觸鬚，皆與觸角作用有關。如將整個吻管作縱斷面的解剖，就顯微鏡去觀察，更可以看到內有許多精細而複雜的結構。

至其消化管的結構，雖各類尙有若干差異，唯就大體上說，迨皆相似。玆以家蠅（*Musca Domestica*）爲例，略爲分別前、中、後、三段消化器叙述於次：

（a）前消化器（Fore Digestive argan）　蠅的消化管中，存有兩種瓣膜，一在胃的前端，稱賁門（Cardiac valve）；一在胃的後端，稱幽門瓣（Pyloric valve）。賁門瓣以前的部分爲前腹（Fore intestine），自唇瓣以次，逐段稱之爲咽頭（Pharynx），食道（Oesophagus），前胃（Proventricutus）成砂囊（Gizzard），及素囊（Crop）。此外別有一對線形的唾腺（Salivary giand），開口於咽頭的前方。吻瓣內部及持以環狀的吻瓣骨片（Labila fulcre）口前骨片（Prostomium fulcre）。吻根上更有上唇基片（Clepeus），咽骨片（Pharyngeal Sclerites orfalcre）及咽骨後緣下部的棒狀骨（Formae）等，各具特殊的形狀，在蠅之分類上頗有價值。咽頭環繞以强力的展咽肌，係消化管的眞正開口處，亦卽唇瓣上各小溝的匯合處，在蠅類別無口腔（Oral）存在，唾腺卽開口於食道，連接於前胃上。前胃之作用甚複雜，或謂用以破碎食物，或謂用以濾過食物，亦有謂爲如唧筒的作用，有唧取素囊中的食物，以引入於胃之效能。但據蘭米氏（Ramme）1913年的研究，則云僅有濾過食物的效用，彼由中腸所分泌的消化液通過前胃而進於素種，因之使食物便於和消化液接觸，而起消化功用。

蠅類素囊甚大，位於食道的側方，爲一有柄的素囊狀體，稱爲吸胃（Sucking-stomach），能貯藏多量的食物。素囊內膜生有褶襞，富擴張性，食物滯留在種內，得依消化液的作用，變澱粉爲糊，變蛋白質爲消化蛋白（Peptone）。其柄部通於前胃，管道狹長，輸運似不迅速，故在過度飽食的情況下，往往因食物的特殊分解，致罹膨脹病以至於死。

（b）中消化器（Mid digestive Organ）前胃後端，通於中腸境界上，有賁門瓣，用以防止食物之逆流，中腸爲口徑較大的管，或稱爲胃（Stomach），其前段附有腺體，能分泌酵腋，以營消化作用。後段兩側，附以一對音叉狀的綫形氣管，左右各分爲二枝，稱爲麥爾比其氏管（Malpigkian tube），開口於中腸之接近後腸處，其管壁由大形的多角細胞所成，其結締質的薄膜內爲角素質的內膜，是司排泄作用的盲管。

（c）後消化器（Hind digestive Organ）自麥爾比其氏管附着點以後的消化管，統稱後消化器，或稱後腸（Hind intosline），爲一細長的管道，可以區分爲廻腸，結腸和直腸。廻腸一名小腸，紆廻屈曲，佔較長的部分，結腸則稱大腸，司吸收作用。接於結腸後部也就是腸的最後一段，稱爲直腸，管壁富於筋肉質，外觀上較他段爲肥大，凡不能消化的廢物，都貯積的這裏，以待排除體外。

（二）蠅類之食物習性　肉食性的蠅，在成蟲時代雖僅食人畜肉之汁，或已腐敗而化成液樣

的肉類，然在幼虫時代，無論其爲腐肉或鮮肉的甚至於生活的動物體，都能充分侵食。其顎片特別發達，極便嚙咬，往往爲人畜之大害。像麻蠅（*Sarcophyga*）屬喜歡食人畜的血肉，產卵於傷口上，增加受傷人的苦痛，（我們在野戰醫院裏，常見到那消毒不周的傷痕裏面，爬出成千成萬的蛆蟲來，便是這肉食蠅在作祟。不過這些蛆蟲所分泌的蛆素，對於斷骨之接合，據醫生證明確有很大的貢獻）。其他像毛緣蠅（*Echinomyice mikado Kby*）黑毛蠅（*Gonia Picca Mots*）大毛蠅（*Servillia lutcola Coq*）等幼虫，寄生於蛾蝶幼蟲上，蠶蛆蠅（*Sturmia Sericarac*）的幼虫，寄生於家蠶體內，可以把寄主完全摧毀掉。牛蠅（*Hypoderma bovis Deg*）的幼虫寄生在牛的皮下；馬蠅（*Gastrophilus equi Ji*）的幼虫，寄生在馬體內；羊蠅（*Otuesms oris L*）的幼虫，寄生在羊的鼻子裏；南美洲之一種青綠金蠅（*Chrgomyia Macellaria*）其虫常寄生在人的鼻孔和外耳道中。這些蠅都會予寄主以重大的傷害，與人畜實有大害。唯此種蠅類與疫病之傳染，少有關係，所以這裏不擬細述。

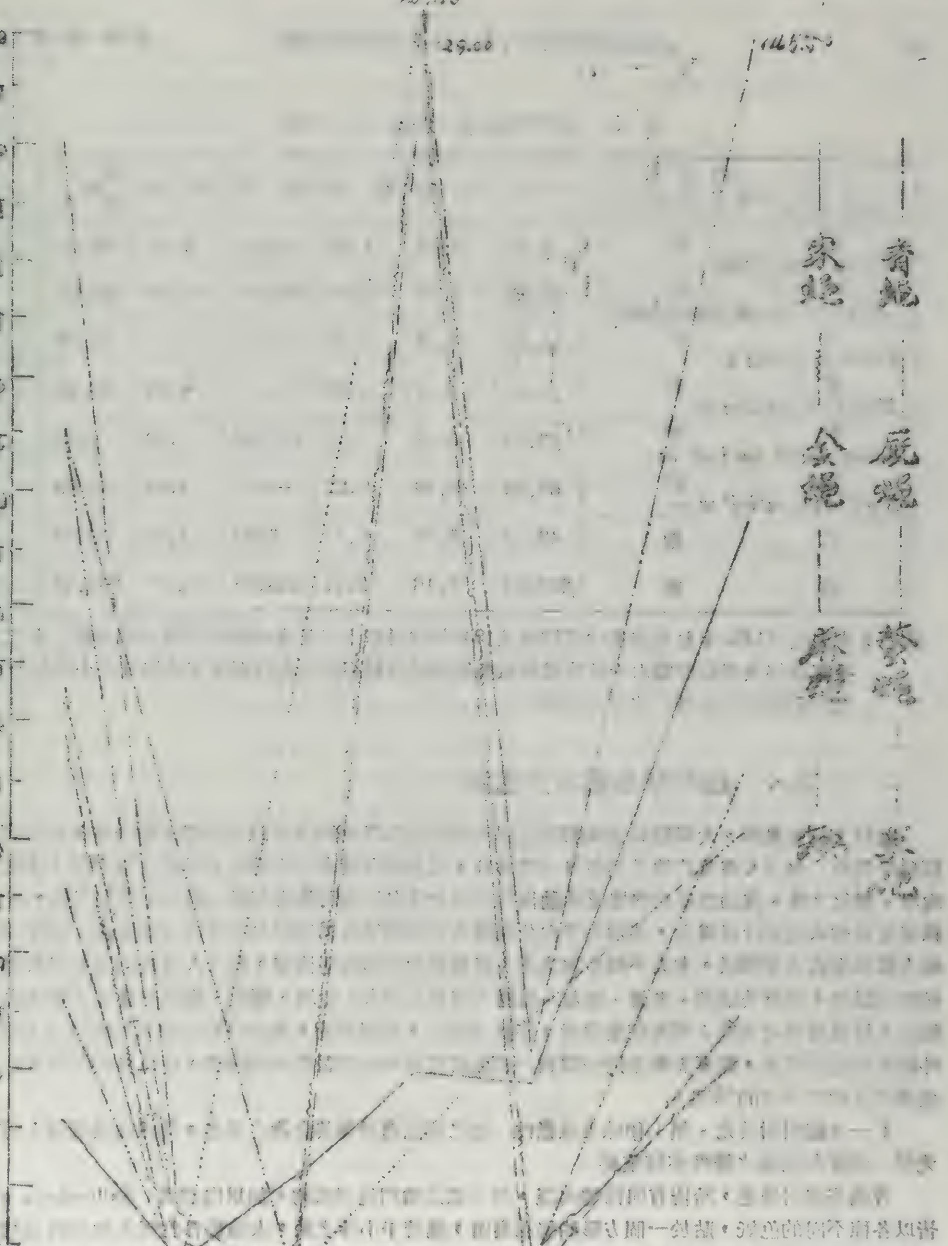
吸血性的蠅，口吻細長，唇瓣上之摄器管退化，吻端具發達之口前齒（*Prostomal teeth*）適於螫刺人畜，如家蠅科之螫蠅（*Stomoxys Calcitransi L*）常麕集牧場或畜舍中，吸取家畜的血液。每當黑雲驟集，天陰欲雨的時候，螫蠅相率飛進家屋中來，因此一般稱之爲厩蠅。非洲有一種刺蠅（*Auckeromyia Lutsla*）其幼虫白晝潛伏土人床下，晚間爬至床上，刺吸睡眠人的血液。另有一種名爲 Phormia 則專吸吮鳥血。其他像虱蠅類（*Pupipara*）中有好幾科的虱蠅，寄生在狗和其他動物體上，吸食他動物的血液。然而這些吸血蠅對於人類疫病之傳染，亦無關重要，均非本實驗所研求的對象。

素食性的蠅，口器最宜於吸食液汁，像寄蠅科的長吻花蠅（*Prosena siberi'a L*）眼蠅科的蜂蠅（*Conops nippvuensis voll*）和黃眼蠅（*Conops nigricuns Ma'r*）都是出入花間採花蜜或樹汁過活的，這素食性的蠅類不但與人無害，且有很大的利益，這裏更無須乎細述。

雜食性的蠅，是吾人最常見，同時也是衛生上爲害最關重要的蠅類。他們的食物不拘動物性的各種肉類，或植物性的果菜，也不管是新鮮的麵包，糖果，或腐爛的屍體，糞便，以及堆肥，廄肥甚而至於污水，塵芥，都爲牠們所愛好。特別對於各種糞便和腐肉，誘惑性之大，實令人驚訝。只要是有這些東西的氣味，馬上就可以見到見到成千蠅子蜂擁而至，不一忽兒，便成爲蒼蠅之藪了。因此普通把這類的蠅，稱之爲腐食蠅或穢物蠅（Filth flies）。不過這些腐食蠅，還各有特殊的愛好，所以對於疫病之傳染，便有了差等。這就是本文研究之中心，也是衛生上必須求得澈底解決的途徑。作者曾採取人糞、豬糞、牛糞，豬欄糞、爛肉、及垃圾等，分別置之捕蠅籠或捕蠅瓶內，用於捕蠅，觀察的結果，白天在室外尋常每小時所捕獲各種蠅的平均數略如第一表：

依下表統計的結果觀之，可知人糞爲青蠅（*Chrysomyia megacephala*）所嗜食；饅頭、糖水則爲家蠅（*Musca domestica*）所愛好；豬糞籠內，固然各種蠅都可見到，但爲數無多；牛糞最易誘集吸血蠅如 *Musina tempestira*；與 *Musina hervei* 及若干螫蠅（*Stomorys calcitrans*）；垃圾內除家蠅和青蠅之外，亦以螫蠅爲多。其他如放置新鮮飯粒之籠內，僅只見到飯蠅，及少數的家蠅而已。是見與疫病最關密切的蠅，仍爲青蠅和家蠅，其餘則關係較淺，爲害當亦比較不甚嚴重。茲依統計數字，製成曲線圖於次：

圖一 各種蒼蠅對於穢物之不同嗜好



表一　蠅類食物嗜好之差別

捕獲蠅種 / 每日所捕蠅數 / 誘捕食物	人糞	牛糞	豬糞	爛肉	垃圾	包穀粉糖水
家蠅 *Musca domestica*	5.70	0.38	1.30	10.00	9.50	57.85
青蠅 *Chrysomyia megacephala*	90.42	0.75	0.10	129.00	11.65	148.50
金蠅 *Lucilia sericata*	38.50	0.10	0.12	140.50	0.40	11.52
廄蠅 *Muscina stabulans*	15.84	0.30	0.22	——	2.75	35.43
麻蠅 *Sarcophaga carinaria*	25.16	0.18	——	270.96	1.52	1.28
螫蠅 *Stomoxys calicitrans*	65.06	0.40	0.22	——	4.95	31.00
其他	42.10	5.05	0.15	5.00	1.93	15.87
總數	282.80	8.16	2.11	555.46	32.70	301.45

說明：本表根據1936年七月在長沙書院坪及1941年六月至十二月在沙縣東門街一帶先後二十二次實驗每次用捕蠅器六十枚分爲五組各組飼以六種不同之食餌而計算其每日八小時每一捕蠅器所捕獲各種蠅之總平均數

三、 蠅類孳生處所之鑑別

蠅類之孳生處所，大都隨其食物習性而異。肉食蠅和吸血蠅多棲息於市場或獸舍中，尋找肉類和活動物（包括人畜及其他昆蟲在內）的傷口，吸取其肉漿或血液爲食，因而產卵於傷口或皮肉中。孵化之後，其幼蟲即在肉塊或活動物體上倚食其肉汁或腐敗的肉漿。素食蠅常集花間，尋找花蜜及樹木的漿汁以爲食，其幼蟲即在花間尋找蜂類的幼蟲爲其宿主，營寄生的生活。這些素蠅大都與疾病少有關係，本文不擬多加論述。至於雜食蠅則隨遇皆安，舉凡人畜的糞便，腐敗動植物的屍體，以至於糟粕、米飯、麵包、糕餅、糖果、污水、垃圾、廢肥、堆肥、及其他發酵的物品，皆爲牠們所喜愛；因而孳生處所，亦極爲廣泛，特別對於人畜糞便和腐敗鳥獸的屍體，格外適於蠅蟲之孳生，這裏需要先把蠅類的一般生活習性和生殖習性加以論述，使之易於明瞭其孳生處所之所以不同的原因。

（一）蠅類對於光、熱、和味之感應性　蠅之棲息處所與其食物之存在，關係固最密切；而光線、溫度和氣味之條件亦極重要。

普通家蠅對於光，殆皆有向性的表現，黑暗總是牠們所厭惡的。加里白禮歐（Gallivaleria）曾以各種不同的色紙，貼於一個方形的蠅籠裏面，隔若干小時之後，去檢點各色紙上所落的蠅數，結果較淺的顏色，落蠅最多；而顏色濃厚者則示厭惡作用，其比率依黑、藍、紫、褐、深紅、綠，淡黃之次序，逐漸加多。普通我們也很容易看到白色或其他淺淡色的衣服上，易於落蠅；黑衣上不大有蠅的蹤跡。所以有人主張房屋內壁，應塗深暗顏色，以減少室內的蒼蠅。這話儘管有

人反對，然事實上黑暗廁所，頗爲適合衛生，衛生工程上常應用此種原理，在建築廁所，同時於出入口處，設一黑暗小路，以絕蠅之往來，誠然至爲妥善。

溫度之高低與蠅類之孳生適成正比。就空間說，熱帶地方，蠅之種類最多，繁殖亦最速；就時間說，夏秋二季蠅類最多，冬季則極爲稀少；就同一地域，同一時季說，往往向陽和靠近廚房比較溫暖的地方蠅類比較多些；如若一室之內，終年皆有較高之溫度，則四季皆可見到蠅類；否則一到冬天，蒼蠅大部消聲匿跡了。

蠅類對於氣味之感應極爲靈敏，拉克（Lacke）曾做過精細的實驗，認爲蒼蠅和青蠅對於溴方(bromotorm)及阿莫尼亞(Ammonia)有吸引作用；松節油(Pine tar oil)和丁香油(Clove oil)則示遠避性。但是松節油被認爲最良好的驅蠅劑。有者常用辣蓼煎湯，揩擦食桌；或用楝樹之葉煎湯洗滌食具，皆收到相當的驅蠅效驗。

（二）蒼蠅之生殖習性及其生活史之觀察：　蠅之生殖習性，各有不同，而其生活史之經過，亦各有差別，茲就觀察所得略述於次：

A, 生殖習性：　蠅類的生殖器官，雌雄異趣。雌蠅腹部由九個環節組合而成；雄蠅只有八個環節，唯在外觀上均僅有四節顯明。其第一節甚小，與第二節完全癒合；第六節以下在雌蠅皆爲產卵器，雄蠅則爲陽莖，至交尾或產卵時，方伸出體外。產卵器平時是摺疊收藏體內，宛若望遠鏡的鏡筒一般。內部生殖器雌雄差異更多，成長的雌蠅在腹部內部，具一對發達的卵巢，就擴大鏡下觀之，常累積着許多橢圓形的卵子，其後端連接於輸卵管上。輸卵管左右匯合成丫字形，其匯合處稱總輸卵管，末端稱陰道，陰道背面有一個圓形的受精囊，和一對分泌黏液的副腺。卵子自卵巢排放至陰道時，受精囊中貯存的精子隨而排出，因以起受精作用，陰道末端接以產卵器，爲產卵之用，成長的雄蠅，腹部具一對長橢圓形的睪丸，後端連以短促的輸精管；輸精管左右匯合，成一條延伸到腹部末端漸漸膨大的射精管。這射精管後端細小如線，連於射精器上；更後段則伸縮自如稱爲陰莖。陰莖平時多收藏在生殖腔裏，亦如雌蠅之產卵器，就普通蒼蠅自蛹化爲成虫後，約二日至十二日開始交尾，這時雌蠅的產卵器伸長，插入雄蠅的生殖腔裏面；而雄器則以陽莖接合於陰道而輸送其精液於受精囊中。交尾時間，自數分鐘至數十分鐘不等。在交尾時，大部雄體抱在雌體背上，停止飛翔，與其他昆虫之接合現象略有不同。

B. 生活史：　蒼蠅交尾後約二三日即行產卵，其產卵處所之選定，大都爲其幼虫採取食料的便利，如家蠅(*Musca domestica*)之卵，常常產在馬糞、人糞或其他動物的固形糞塊上；青蠅((*Chrysomyia megacephala*)的卵喜歡產在坑廁的糞液、污水或淡薄人糞上；金蠅(*Lucilia sericata*)麻蠅(*Sarcophaga carinaria*)的卵多產在鳥獸腐肉、魚屍及人糞上；牛蠅(*Hypoderma bovis Deg*)馬蠅(*Gastrophilus equi Ji*)產卵於家畜皮下；毛蠅類，(*Echinomyice mikado kby*)大毛蠅(*Servillia luteola coq*)產卵在螟蛉的幼虫體中，殆皆爲其幼虫生活之便利。茲就蠅之產卵習性及其各時期幼虫的生活情況，分別述之。

(a) 蠅類產卵習性　蠅類產卵時，大概避開陽光，延伸其產卵管，插入糞塊或其他孳生物質中，然後把一個個卵子從輸卵管中連續排放出來，如不受他種妨害，一次產下的卵，大部互相黏着，成白色小塊。普通每次所產的卵，在家蠅約自一百至一百五十枚，平均數爲一百二十枚左右；青蠅則自十九枚至二百四十六枚不等，平均數約爲182。家蠅一生，可以產卵一至五次，青蠅僅只二次而已。其他各種蠅卵之產量，及其產生之次數，各有不同，大都受濕度、溫度及食品之影響甚大。

蠅卵大都呈長圓形，微見彎曲，前端較後端細小，背面有條平行之縱脊起線，全長約一公厘許。色白、略現淡黃色，孵化時卵殼即沿縱起線裂開。卵期之長短，因溫度濕度而異，在七八月間普通十二小時即可孵出（家蠅之卵期比之青蠅略為長些）。蠅類除麻蠅等極少數為胎生(Larviparous)者外；普通皆為卵生（Oviparous），其生活史必須經過幼虫蛹而後羽化為成蠅。

(b) 蠅類幼虫之發育經過 蠅之幼虫在發育過程中，須經二次脫皮，第一期幼虫長僅一公厘許，全體共十四節，缺前氣孔，僅具後氣孔二個，位於第八腹節之末端，以糞便及糞便內之微生物為食。經過時間，家蠅（*Musca domestica*）約十一小時（0.6—1.0 平均為0.9日）；青蠅（*Chrysomyia megacephala*）二十四小時（1.0—2.0 平均為1.03）長短亦隨氣溫及濕度而略有差異。

第二期幼蟲之長度，家蠅約三公厘，青蠅四公厘，其胸部第一節之背側後部，有一對具部分枝之前氣孔。其分枝之數目，因種而異，為分類學上之重要根據。每一個枝之頂端，有一小孔，前氣孔即由此若干小孔集合而成。蟲之第八腹節末端，有一對後氣孔，每孔由二裂隙狀之小孔所成，本期經過時間與第一期大致相同，家蠅為0.6—1日，平均0.9日；青蠅則為1.0—2.0日，平均1.01日。

第三期幼蟲長約十三公厘，青蠅可及十八公厘；經過時間家蠅為一日至四日，平均二日；青蠅一日至六日，平均2.8日。至本期之末，大多數幼蟲離其孳生處所，爬匐至較乾燥而寒冷之地帶，如廁所、廄舍及垃圾堆附近之泥塊。土堆下面，或為石隙縫中，停止攝取食物，準備蛹化。

(c) 蛹期之蛹化 當第三期幼蟲蟄伏於乾燥處所後，蟲體漸次短縮，成橢圓形，外皮硬化，顏色由黃而棕褐，終於變為深褐色，稱之為蛹。蛹之外皮與蛹體分離，即稱蛹殼(Puparium)。普通蛹體全長約為6至7公厘，寬2至3公厘；前端兩側各具一小突起，上有若干小孔，與外界相通，為呼吸之門戶。蛹經三五日羽化而為成蠅。其蛹期之長短，視溫度而異，家蠅自3至8日，平均為5.4日；青蠅自3.5至7日，平均為4.8日。唯在冬季，氣候寒冷時，可以延長至四五月之久。

(d) 羽化成蟲之經過 蛹成熟後其頭部之額囊（Ptilinium）連續伸縮，發生突破力量，使蛹殼之前端[illegible]，成蟲乃由此孔爬脫殼而出。初羽化之蠅，胸腹兩部皆極瘦小，外皮柔軟，翅皺疊折於背上，無飛翔能力，迨一日後，兩翅展開，額囊收入頭內，成蟲之特有色澤及習性，始漸次顯現。

(三) 蠅食性孳生處所之分析 蠅類孳生處所之決定，主要因素有三：其一、為該蠅幼蟲生活之便利；其一、受其本身食物嗜好所誘集；另一、則為光線、色彩、溫度、及氣味所影響。前文對此，已有論述，毋俟詞贅，唯此三因素之關係尤以最切者，仍以第一項為重要。蓋為下一代繁殖種族，乃動物與的普通本能，蠅類繁育幼生處所之選擇，尤見慎重。作者曾就各個不同的天然環境中，採集一般最易誘集蠅類之穢物如：液樣人糞，固形人糞、豬糞、牛糞、垃圾、豬臟爛等，先後四十餘次，各以一定之分量，分別裝入廣口瓶中；並取新鮮的豬肉或牛肉，置於露天環境中，任由蠅類集而產卵後，併入上列各組，以待幼蟲孵出而檢查之，所得結果如第二和第三表及第二圖所示：

表二　蠅類孳生處所之差異

	養蠅物品	液樣人糞	固形人糞	豬糞	牛糞	豬欄糞	垃圾	爛肉
	養蠅次數	45	40	30	35	30	30	10
	孵出蠅之總數	2671	3166	1341	1054	47	987	2369
每種數所佔之數目	家蠅 *Musca domestica*	56	541	494	10	7	419	8
	青蠅 *Chyrsomyia megacephala*	2151	135	——	——	——	426	28
	金蠅 *Lucilia sericata*	4	39	1	2	1	23	731
	廄蠅 *Mucina stabulans*	——	178	——	3	2	4	——
	麻蠅 *Sarcophaga carioaria*	411	906	201	2	3	35	1482
	螫蠅 *Stomoxus calicitrans*	——	70	1	3	22	79	——
	其他	49	1297	644	1034	12	1	20

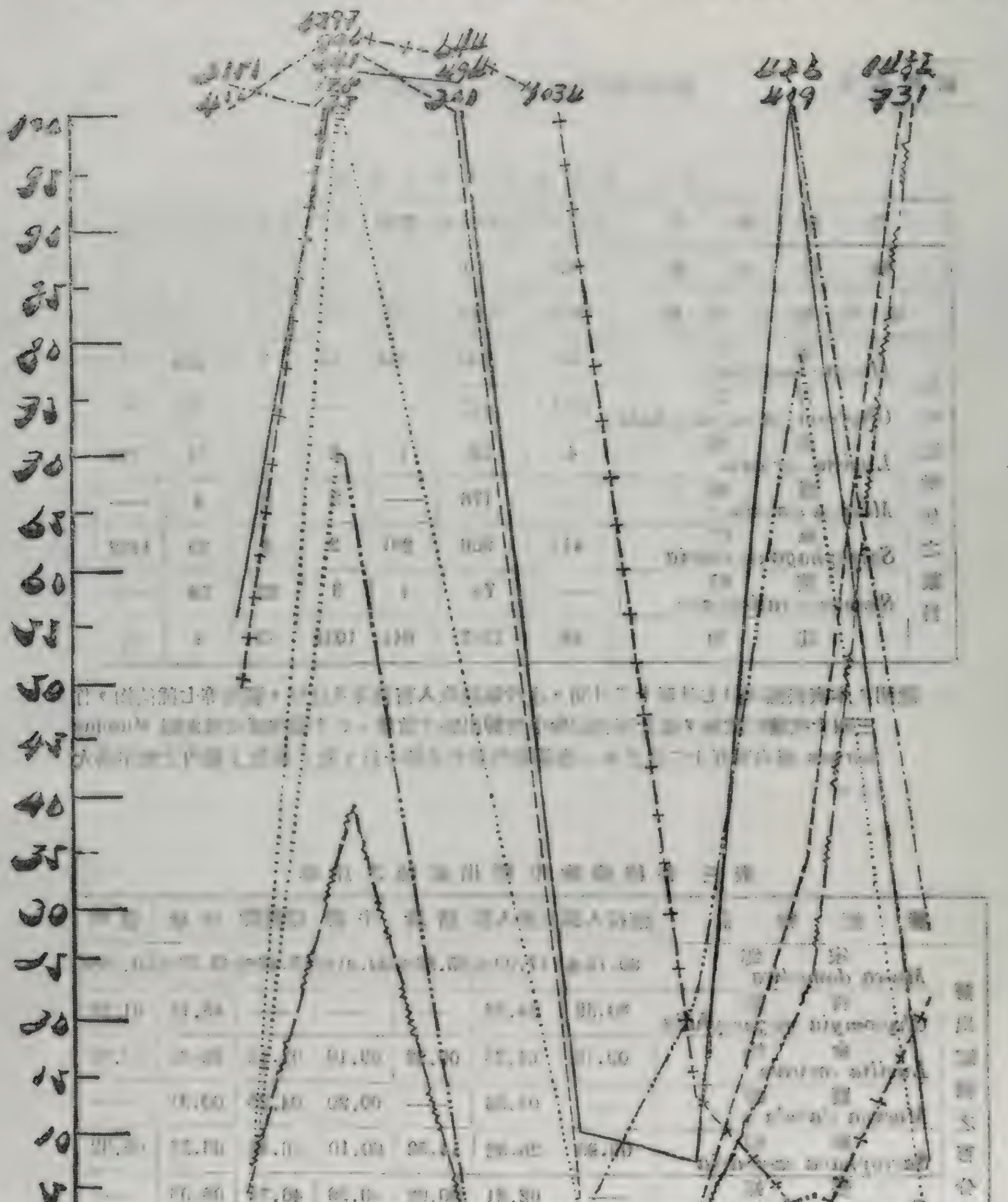
說明：本表根據1941七月至十二月間，在沙縣採取人畜糞便及垃圾，爛肉等七種穢物，作三四十次養蠅試驗，而計算各穢物中所孵出蠅之數量。（牛糞內孵出吸血蠅 Muscina herveis 至六百五十二隻之多，豬欄糞內亦曾見到一只，故「其他」欄內之數字甚大）。

表三　各種穢物中孵出蠅種之比率

	養蠅物品	液樣人糞	固形人糞	豬糞	牛糞	豬欄糞	垃圾	爛肉
孵出蠅種之百分比	家蠅 *Musca domestica*	00.10%	17.02%	35.52%	00.91%	15.42%	42.52%	00.35%
	青蠅 *Chysomyia megacephala*	80.52	04.82	——	——	——	43.12	01.25
	金蠅 *Lucilia sericata*	00.15	01.23	00.22	00.19	02.12	02.35	32.21
	廄蠅 *Mucina stabulans*	——	05.60	——	00.29	04.25	00.31	——
	麻蠅 *Sarcophaga carioaria*	00.93	28.32	14.32	00.19	06.46	03.52	65.32
	螫蠅 *Stomoxys calicitrans*	——	02.21	00.02	00.29	46.79	08.03	——
	其他	18.30	40.80	49.92	98.13	24.96	00.10	00.87

說明：根據前表孵出蠅之數量而計算各種穢物內蠅種之百分比。

圖二. 各種蒼蠅在不同孳生物質中之繁殖差



至各種糞便物品內所發出之蠅，種類大致皆同，然其百分比之差異極爲顯著，若液樣人糞所發出之蠅種中青蠅（*Chrysomyia megacephala*）佔80.52%，麻蠅（Sarcophaga）佔15.40%，家蠅（Musca domestica）僅佔0.1%，廄蠅（Stomy calicitrans），腐蠅（*Mucina stabulans*）則絕無足跡可尋。固形人糞發出者以麻蠅最多，佔28.32%有奇，家蠅次之，佔17.02%；青蠅（4.82%）腐蠅（5.60%）爲數至少，狗糞內僅只有家蠅（35.52%）麻蠅（14.32%），而無青蠅、廄蠅；至於金蠅、腐蠅，雖偶然亦可發見，但皆無關重要。牛糞內發出之蠅，種類固甚複什，但除吸血蠅（*Musina hervei*及*Musina tempestiva*）外，所見者均極微量。猪欄糞最不適於蠅之孳生，除極少數之廄蠅（46.79%）及家蠅（15.42%）外，其他蠅子即或可以見到，亦不過寥寥一二而已。唯垃圾反爲家蠅及青蠅孳生之最優良物品，二者之百分率，均在42%以上。廄蠅（8.03%）麻蠅（3.52%）金蠅（2.35%）亦不爲少。腐肉則爲麻蠅（65.32%）金蠅（32.21%）孳生之藪，然種類頗見單純，且機會亦較不易得，就衛生上言，自以孳生於液樣人糞及垃圾中之青蠅爲傳染疾病之最可怕物，蓋液樣人糞大多爲病人所排泄者；垃圾中多有病人之痰涕和食渣，亦甚危險。廄蠅及其他吸血蠅大都蕃殖於畜舍中，雖與獸疫之傳播有關，然在人類衛生上影響殊少。家蠅固爲公認之傳播疫病媒介，然比之青蠅則有天淵之別。蓋家蠅棲息之處所，除垃圾爲危險物外，其他狗糞及固形人糞，這皆與疫病少有關係。至孳生在爛肉及人畜傷口上的麻蠅，僅止毀損食物及增加受傷人畜若干苦痛已耳，與疫病之流行更少有影響。是則糞便及垃圾之管理，爲衛生行政上當務之急，反之，猪欄糞及牛糞，非祇與人類之健康無甚妨害，且對於農村經濟有巨大貢獻，謀衛生及經濟建設者，應分別加以注意，不能同樣以穢物視之。

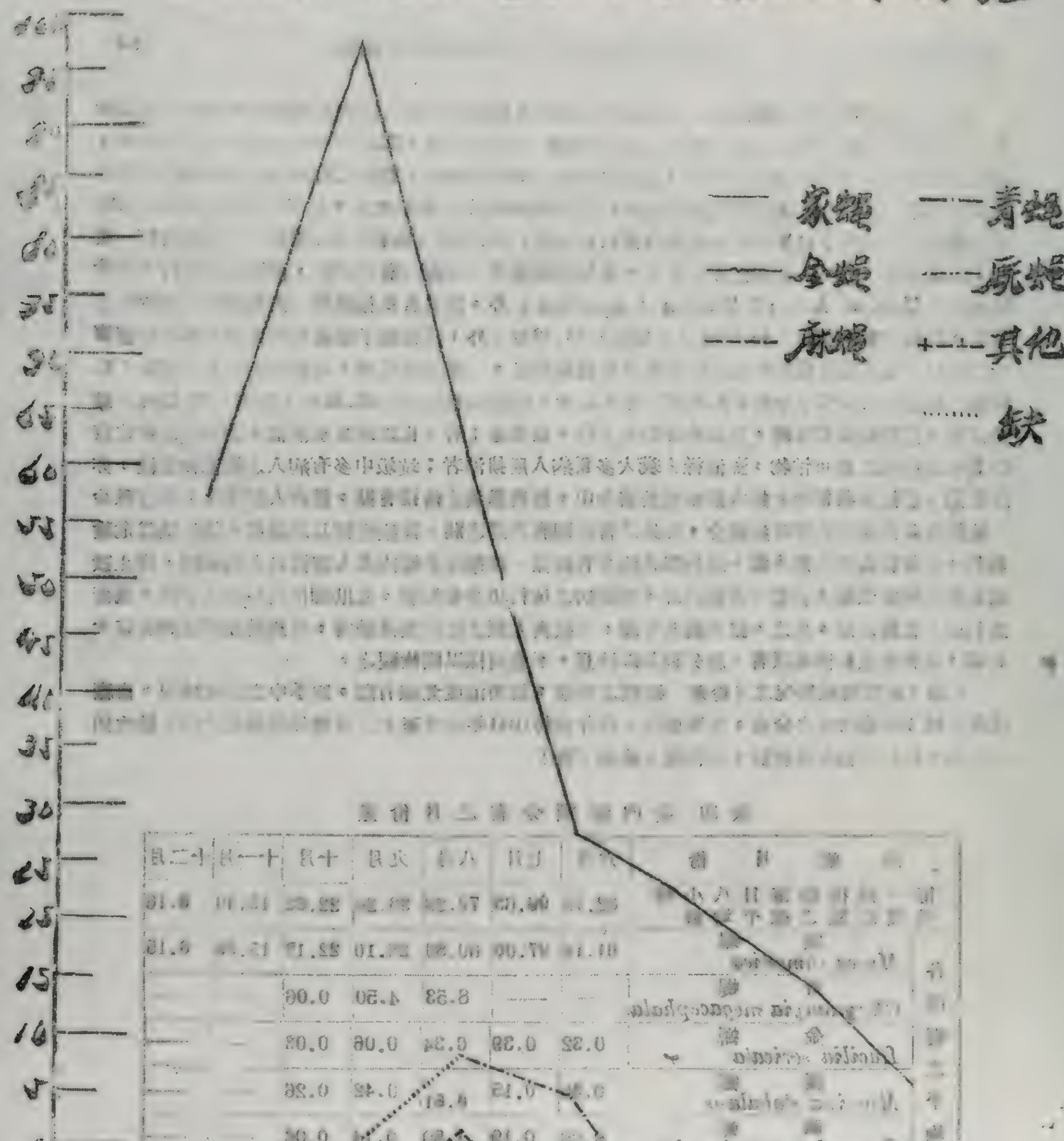
（四）蠅類蕃殖情況之月份差　蠅類之蕃殖，旣與溫度光線有關，四季中之孳生情況，自應時有不同；而室內外之分布，差異更甚。作者曾將1941年六月至十二月間分組舉行之四十餘次捕蠅試驗，依照月份加以統計，所得結果略如下表：

表四　室內蠅類分布之月份差

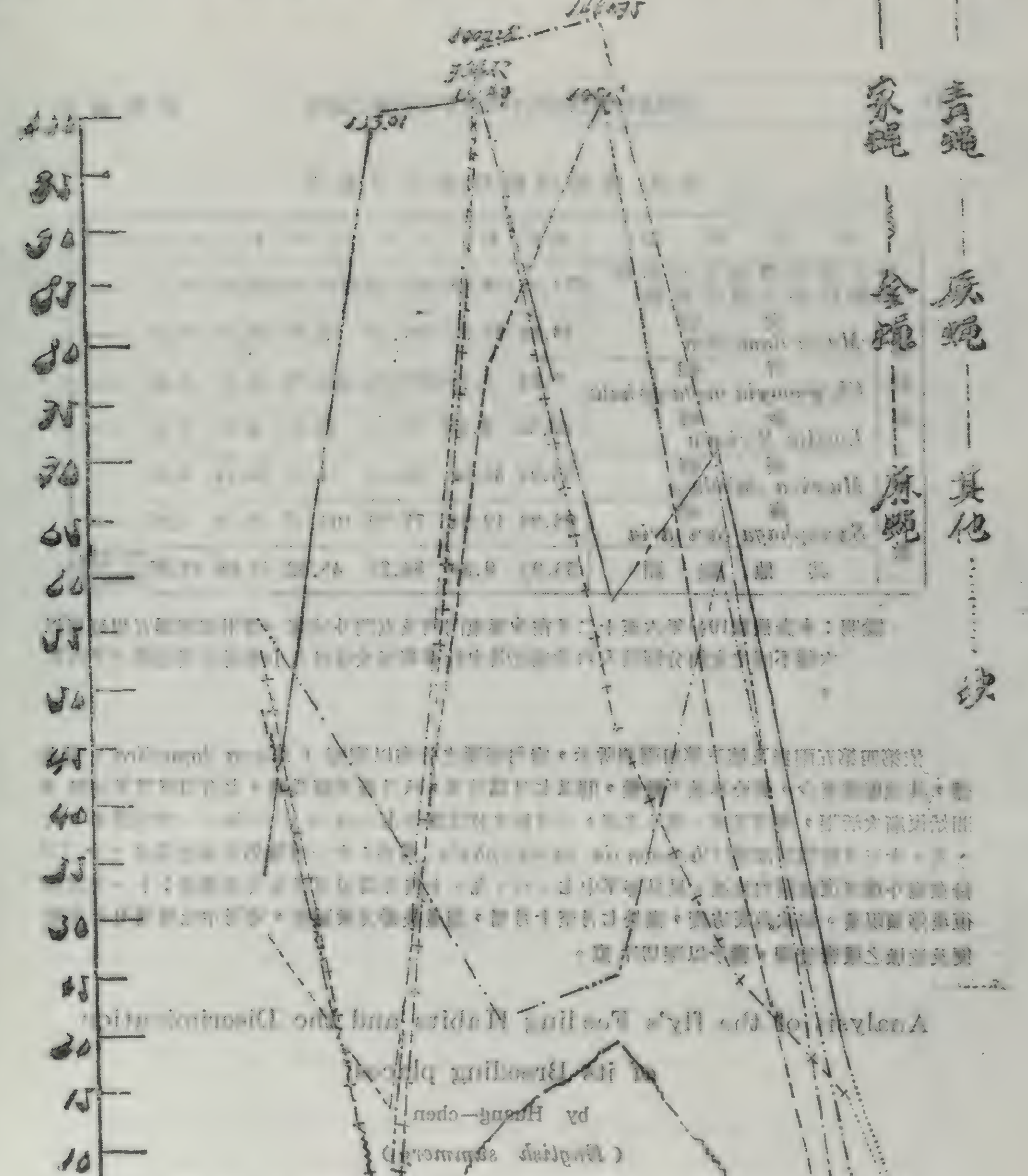
捕蠅月份		六月	七月	八月	九月	十月	十一月	十二月
每一捕捉器每日八小時捕獲蠅類之總平均數		62.19	96.63	72.29	33.26	22.62	15.40	6.16
各種蠅之平均數	家蠅 *Musca comestica*	61.14	97.06	60.80	28.10	22.12	15.39	6.15
	青蠅 *Chrysomyia megacephala*	——	——	8.53	4.50	0.06	——	——
	金蠅 *Lucilia sericata*	0.32	0.39	0.34	0.06	0.03	——	——
	腐蠅 *Muscina stabulans*	0.30	0.15	0.61	0.42	0.26	——	——
	麻蠅 *Sarcophaga carinaria*	0.09	0.19	1.89	0.14	0.06	——	——
	其他蠅類	0.34	0.84	0.12	0.04	0.09	0.01	0.01

說明：本表根據1941年六在沙縣科學館原址內（卽本縣動植物研究所初期所址）用捕蠅器五組每組以六種不同之食餌（糖水麪包及人類糞便）分別置於六枚捕蠅器中而計算其每一捕捉器每日八小時所捕獲蠅類之平均數。

圖三 各種蒼蠅在室內分佈之月份差



圖四 各種蒼蠅在室外分布之月份表



表五　室外蠅類分布之月份差

捕獲月份		六月	七月	八月	九月	十月	十一月	十二月
每一捕捉器每日八小時捕獲蠅類之總平均數		229.12	198.06	1361.38	1729.83	262.15	36.25	——
每種蠅之平均數	家蠅 *Musca domestica*	33.45	133.01	161.47	56.22	69.18	15.95	——
	青蠅 *Chrysomyia megacephala*	2.64	5.18	1007.28	1480.75	66.48	0.45	——
	金蠅 *Lucilia Sericata*	47.59	8.08	11.31	18.16	6.56	0.22	——
	廄蠅 *Muscina stabulans*	55.25	38.06	20.31	24.21	59.01	6.51	——
	麻蠅 *Sarcophaga carinaria*	28.29	12.84	77.39	105.17	36.24	0.25	——
	其他蠅類	53.00	0.89	84.22	45.32	24.68	12.87	各組均無所獲

說明：本表根據1941年六至十二月在沙縣東門街及東門外城郊一帶用捕蠅器五組每組以六種不同之食餌分別裝入六枚捕蠅器中計算其每夜每日八小時所捕獲蠅類之平均數。

依第四第五兩表及第三第四兩圖所示，室內蠅類之分布以家蠅（*Musca domestica*）為主體，其他蠅種至少。至於繁殖之數量，則以七月為最高，八月後逐漸低減，大約須至翌年三四月間始復漸次活躍，成週期律。室外之蠅，八月份之前以廄蠅*Muscina stabulans*、家蠅為多，八、九、十三月份則以青蠅(*Chrysomyia megacephala*)為盛；十一月後仍以家蠅為多。十二月份在室外幾無復蠅類的蹤迹。足見每年中七、八、九、十四月為蠅類孳生最盛時期；十一月之後復呈停頓現象。如欲澈底防疫，應於七月至十月間，盡量鼓勵民衆滅蠅，特別在此時期內對於糞便及垃圾之嚴密管理，應予以深切注意。

Analysis of the fly's Feeding Habits and the Discrimination of its Breeding places

by Huang—chen

(*English summery*)

Flies feeding and breeding are closely related to the health of man and animal; so there is an urgent need of studying their habits of getting various kinds of food, and of investigating breeding places.

In our experiments we used the evacuations from human beings, cows, and pigs, the dirt from the pigsty, rotten meats, rubbish, bread and sugar waste or molasses to attract all kinds of flies. These tempting materials were put in each fly cage, and

then their different effects calculated.

We studied the species of flies and their breeding by different fly covers. In each fly cover was put only one kind of matter, such as human waste matter, or one of five other common rotten matters that are easily detected in the environment.

We studied the feeding materials for flies and calculated the different species coming out from them. By this method we got their percentage and their average.

From June 1941 to Dec. of the same year, we analysed their feeding habits, taking five types of waste material each time to catch flies. On 7 months we took 22 times and each time we used 30 fly cages and caught over 20 species among more than 10,000 flies. We calculated their average in each fly cage each day.

The result of the analysis is shown on table ONE

Baiting materials / Catching flies	Evacuation from human beings	Evacuation ftom cows	Evacuation from pigs	Rotten meats	Rubbish	Bread and sugar
Musca domestica	15.70	0.38	1.30	10.00	9.50	57.85
Chrysomyia megacophala	90.42	0.75	0.10	129.00	11.65	148.50
Lucilia sericata	28.50	0.10	0.12	140.50	0.40	11.52
Muscina stabulans	15.84	0.30	0.22	—	2.75	35.43
Sarcophaga carnaria	25.16	0.13	—	270.96	1.52	1.28
Stomoxys calicitrans	65.06	0.40	0.22	—	4.95	31.00
Other flies	42.10	5.05	0.15	5.00	1.93	15.87
	282.80	8.16	2.11	555.46	32.70	301.45

Table one

The experiments regarding breeding places also began in June and ended in Dec. 1941 We observed and experimented 40 times. We divided the experiments into 6 groups as before, from the various fly feeding materials. We discovered that there were many kinds of flies present; and that each had its own principal germs. The results of our investigation are shown on table TWO

Feeding materials		Liquid evacuation from human	Hard evacuation from human	Evacuation from pigs	Evacuation from cows	Dirt from pigsty	Rubbish	Rotten meats
Experimented times		43	40	30	35	30	30	31
The flies coming out from feeding materials		2671	3166	1341	1054	47	987	2269
The percentage and average of different fly germs								
Musca domestica	Percentage	0.10%	17.02%	35.52%	0.91%	15.42%	42.52%	0.35%
	Average	56	541	494	10	7	419	8
Chrysomyia megacophala	Percentage	80.52%	4.82%	......	......	......	43.12%	1.25%
	Average	2151	135	......	......	......	426	28
Lucilia sericata	Percentage	00.15%	1.23%	0.22%	0.19%	2.12%	2.35%	32.21%
	Average	4	39	1	2	1	23	731
Muscina stabulans	Percentage	......	5.60%	......	0.29%	4.25%	0.31%	......
	Average	......	178	......	3	2	4	......
Sarcophaga carinaria	Percentage	00.93%	28.32%	14.32%	0.19%	6.46%	3.52%	65.32%
	Average	411	906	201	2	3	35	1482
Stomoxys calicitrans	Percentage	......	2.21%	0.02%	0.29%	46.79%	8.03%	......
	Average	......	70	1	3	22	79	......
Muscima hervei	Percentage	......	......	......	61.82%	2.12%	......	......
	Average	......	......	......	652	1	......	......
Other flies	Percentage	1.830%	40.80%	49.92%	36.31%	22.84%	0.10%	0.87%
	Average	49	1297	644	382	11	1	20

Table two

In addition to the above mentioned, experiments we made a total monthly calculation of the attracted flies in relation to the number of flies bred in order to compare the difference of the rates of their multiplying each month.

From the above charts we can see very clearly that, in relation to our human health, *Chrysomyia megacephala* is our greatest enemy; *Musca domestica* and *Lucilia Sericata* rank next. They multiply most flourishingly in the months of Aug. Sept. and Oct. One must pay special attention to sanitation, and to cover well all the public toilets, cess-pools, dung-hills and rubbish piles, and also to promote the fly exterminating movement, in order to save thousands of human lives from being killed by these insects each year.

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漳州柑桔之病害

（第一次報告）

陳其僕　邱瑞珍

Phytopathology of citrus in Chanchow, Fukien

(1st Report)

by

Che-Poh Chen and Shui-chen Chiu

一、引　言

我國柑桔產區以廣東爲最盛，福建次之，廣東潮汕爲世界名產，佔我國果品國際貿易之首位，惟病蟲爲害至爲猖獗，黃龍病侵襲尤更劇烈，其損失之重，殆難估計，且此病富蔓延性，柑園中一旦發生，必至全園柑樹死亡爲止（參閱福建省立農學院新農季刊研究專號三卷三期黃龍病研究）。廣東各地柑區如番禺，潮縣等地此病之發生亦日益嚴重。漳州地連潮州，爲福建產柑之豐區，苗木來源亦多仰給於潮州，諸種病害，尤其是黃龍病發生情形，均值供吾人研究，作爲解決柑桔病害問題之資料。

民國三十三年秋，本院派其僕調查漳州柑桔病害與實施新法包裝貯藏等工作，因之得以實地觀察漳州柑桔之病害情形，惟調查範圍限於經費，僅爲龍溪，長泰，南靖，海澄，華安等縣，調查工作由其僕負責，而標本之整理，病害之培養，接種與鑑定，則由瑞珍君幫同工作，共草此篇，以供讀者參考，但文中錯誤在所難免，更希讀者不吝指正是幸！

調查工作經費，一部係農林公司資助，在工作過程中，承農林公司種苗部經理孫廷謨副理李哲，暨龍溪農場洪麗士，長泰陳步瀛諸先生之協助，統此表示謝忱。

二、漳州柑桔業之概況

（1）栽培區域：　漳州柑桔栽培區以龍溪爲最大，漳浦次之，長泰又次之，其他各縣則甚稀少。據柑農報告，現存柑樹僅佔戰前百分之十至二十，因情形複雜，殊難獲得確實之統計，長泰之武安鄉，安仁鄉栽培最盛，約有千畝，龍溪之南鄉，角尾，石碼等地亦僅餘千畝，但以全縣計之

，恐不足萬畝之數。龍溪之埔南以產柚著名，柚園尚存數千株，其他柑區僅餘零星柑落，因大部園地已改稻田或栽植其他作物矣。

（2）主要品種：　漳州各地栽培之柑桔，品種較廣東潮州爲複雜，種類亦多，其主要品種不外椪柑，蕉柑，印子柑，雪柑，福桔，臍橙等是。前三者佔面積較廣，後三者次之，生長情形，以印子柑最好，產量亦豐，品質亦甚甜美，爲漳州柑桔最有希望之品種，其他品種雖亦不劣，但似不如潮州各地栽培之良好，埔南之柚與平和琯溪之蜜柚總甚優美，具有可能發展之天賦條件，龍溪翁健鄉之晚熟橙，南靖天民農場之臍橙與蕉柑（只一株似爲新種），皆值得研究與繁育者。

（3）園地管理：　由園地所表現情形與一般柑農所談之種柑常識，遠不如潮州柑農經驗之豐富，除少數之私人農場（如四維農場）管理尚有完善外，一般園地管理甚形粗放，尤其是一般公營農場之管理更見疏忽，[illegible]荒蕪，柑樹枯亡，產量劣[illegible]，今日所見現象不外（1）園地雜草叢生，柑樹生長不良（2）應灌溉而不灌溉致影響果實不產量（3）柑[illegible]顯呈失肥狀態（4）病蟲害未見防除（僅少數柑農捕殺天牛幼蟲）。

（4）運銷情況：　據民國二十五年胡昌熾先生之報告，漳州所產柑桔果實值一百萬元，三十年管超先生報告，戰前年產五十萬担，出口三十萬担，二十九年統計僅二十萬担。今年柑桔果實產量，雖未能精確統計，根據一般觀察，恐不上五萬担。廈門淪陷前，漳州果實經此輸出上海南洋各地，淪陷後，除少數部份走私出海外，其餘多賴內銷，但內銷因交通困難與包裝處理欠當，因之腐爛甚多，加重園主損失。今日漳柑之運銷約分三條主要幹線，一由南靖至龍巖，二由華安至永安，三由海岸線出海，包裝亦由木桶，木箱而改用竹簍，但因商人墨守舊法，選果與包裝處理尚未識應用，致運銷與貯藏期間腐爛率頗高。

（5）病蟲害：　漳州柑桔病蟲爲害至烈，其種類尤多於潮州，蟲害較病害爲重，爲害烈者首推天牛 *Melanauster chinensis* Lorst. 其他爲刺粉蝨（*Aleurocanthus sp.*）介殼蟲，灰背翅蛾（*Gcioba sp.*）潛葉蟲（*Phylcocnistis citrella*）等是。

三、漳州柑桔之病害

漳州柑桔之病害爲最嚴重而久被人忽視之問題，今日之柑桔園中要選一無病之樹誠屬難得，病害之種類亦甚複雜，致病程度亦因種類不同而各異，有者能促致病樹全部死亡，有者僅致病樹生長不良，產量減少與市場損失，茲將一部病害分別簡述之

1、黃龍病：（Lip-cOlorosis）

黃龍病乃潮州柑農之俗名，爲廣東柑桔最嚴重之病害，漳州柑農則稱之爲黑根尾，亦漸爲漳州最猖獗之病害，故此病若不急求防治，非但閩粵柑桔業趨於沒落，恐將爲整個柑桔業之大患。

1.歷史分佈：　黃龍病之發生歷史無從考得，據老農口述至多不過數十年，但過去未若今日之猖獗，據民國三十一年嶺南大學林孔湘教授之口頭報告，龍溪柑桔雖有類似黃龍病者亦甚輕微，此次調查龍溪，長泰，南靖，華安，海澄等縣柑區，知各區柑樹均罹有此病，且以龍溪受害最烈，長泰次之，園中柑樹受病百分率間有達50%至100%者，如四維農場之柑樹約有百畝幾全部因罹病而掘除，故此病在最近數年始引起一般柑農之注意，蓋其分佈範圍日廣，舉凡栽培柑桔之地區，幾全部有此病之侵害。

2.病徵：　黃龍病之顯著特徵，爲某一枝之梢端枝葉突呈黃萎，而其他枝叶果仍能正常生長，漸次蔓延及樹之全身，因之全株枝葉均呈黃萎狀，故稱之曰黃龍病，病葉尤其是嫩葉多在葉

脈間呈黃斑，受病枝叶漸次枯萎，但亦有新長枝葉顯呈黃化者，但枝節短，葉叢密，葉片狹小豎直，色淡黃，乏光澤，同時根部呈腐爛狀，根尾尤甚故又稱黑根病，又在果實幼小時受病者則果實變小畸形，在果實長大時受病者則果實早黃味酸，且易落果。

3. 病原：據嶺南大學植物試驗場研究之結果可能爲毒素性（Virus）議經各地報告，此病尚未明瞭，有者認爲水害（Water injury）或因土壤與施肥關係，有者認爲病毒，且能傳染，雖經撥除補植者仍能受病，潮汕苗木多移植致其爭傳[illegible]漳州柑桔黃龍病似傳自潮汕輸入之苗木。

經用病根提離結果得 *Fusarium Sp.* 真菌，此與上海商品檢驗局與嶺南柑桔病害研究所所提出之結果相同，但此菌與黃龍病之關係若何尚待研究證實之。

2. 黑斑病（Black spot）

黑斑病爲漳州柑桔最普遍而又猖獗之病害，由 *Phoma citricarpa* Mc. Alp. 所致果實受病後呈黑斑點，外觀既難看不合食者心理，貯藏亦易腐爛影響售價降低，中以蕉柑福柑，椪柑受病較烈，病斑多在果實罕見於枝葉等部，斑點初見於葉面者爲紅色後漸變暗色或更完全變黑者，初之斑點徑約1—2mm. 但亦有擴大至8—10 mm. 者當病斑成熟時邊緣高起呈紅棕色，中央凹下亦顯棕色。

3. 黑星病（Melanose）

此病爲漳柑病害之最顯著者由 *Diaporthe citri* (Faw.) Wolf. 所致，各地柑桔均有發生，椪柑，蕉柑，受病較烈，印子柑次之果實受病呈黑點之星，非但根致產量與市價損失且礙果實之包裝與貯藏。病徵發生與幼果枝葉正在生長之時，若幼果病斑甚多，則此果發育不良，[illegible]致早期落果，該病果能達成熟而[illegible]發育不良現象則亦必影響於販售或列居低級地位，據 Floyd 及 Stevens (1911) 稱「棕色高起組織係充滿膠質之細胞形成之」每斑徑約0.5—1mm. 病部常呈龜裂[illegible]。

4. 瘡痂病（Scab）

此病由 *Sphaceloma fawcetti* Jenkins. 所致，亦爲漳柑嚴重病害之一，椪柑及橙受病較烈，果葉枝等部均能受害，尤以幼果及新嫩枝叶爲然，苗木如橙，檸檬，酸橙等受病亦烈，外觀病徵爲不規則之木栓狀高起病斑，通稱疣（Wart），或瘡痂（Scab）果實受病後常變扭曲，如檸檬，椪柑，四季桔，紅桔，及橙等爲是，初起病斑突起點甚小，待果增大後乃漸變大而明顯，終呈黃色或灰白色，至於葉部病斑初爲半透明小斑點，後中央部高起時或平坦或凹下，初爲淡黃色，繼因病菌之分生孢子梗及分生孢子之生成而呈黃褐色，老斑則色變暗褐色矣。病斑在葉之兩面均有，但以底面居多常爲單獨或成羣，偶則排列成小環狀或混雜一處呈[illegible]狀。

5. 潰瘍病（Canker）

潰瘍病由 *Phytomonas citri* (Hasse) Com. S. A. B. 所致爲漳柑普遍病害之一，印子柑，蕉柑受病尤烈，叶枝果等部均被侵害，因此病而致落果者損失頗重，其在生長之幼葉，罹病初期爲黃色小斑點徑約1/16吋左右，偶然見於叶之底面，後漸有白色海綿狀之小突起位於葉底，同時表面亦有高起如海綿組織，在病烈時見海綿狀組織爲白色，否則爲淡黃褐色或棕色，若病勢仍繼續進展則叶表光滑之斑點突起裂開，而成粗糙之海綿狀病斑，且粗糙而積濕組織出如水漬狀，叶面棕黃，或綠色而無光澤，在生長二十日左右之葉其病斑徑約3—4mm. 兩面粗糙而色黃，葉綠素退失，老叶之病斑棕色硬化若木栓，但幼斑常爲圓形，而周緣界線明顯，老斑形甚不規則而界線難分，至於果部病徵亦與葉部相同，病斑爲海綿組織狀裂開在表面或深入其底層組織，

病斑有光澤裂口明顯，邊緣呈油漬狀，此與蒂部之呈黃色水漬狀者不同，且僅限於皮殼而不侵入果肉。

6．青黴病（Blue contact mold）

此病由 *Penicillium italicum* Wehmer. 所致，爲漳柑之市場包裝，運銷以及貯藏方面發生最劇之病害，損失可達百分之五十以上，在包裝貯藏試驗期間，果實之腐爛損失大半由此病所致之其軟腐與綠黴病大致相同致病原因給半起於傷害，由於接觸傳染而廣佈者較爲常見，其染及無傷害之果，多由果蒂處侵入，此外亦有由其他傷害及擦傷處傳入，初起病部柔軟而呈水漬狀易爲手指壓破，其病斑之增大較綠黴病害爲緩。當其增大時有白色菌絲，生長於果面繼之有孢子叢之產生，且向柔軟部份擴展終至果實無餘，待腐爛部份顯著時，其孢子叢常深入果內而在果皮之海綿組織中或果之中心部內聚積，其胞子叢因時間之增久而變爲暗棕色果內組織破壞較綠黴病爲甚。

7．綠黴病（Green mold）

此病由 *Penicillium digitatum*. Sacc. 所致爲害狀況與青黴病同，起初與其他皮殼傷害者無異，亦可由接觸傳染但不及青黴病爲速，先皮殼變軟如水漬狀易爲手指壓破腐爛甚速時，且有白色菌絲佈於表面，旋有青色孢子叢產生，動之則孢子飛散如煙霧，綠色部份初形成於中央，不久周緣繞以帶狀之白色菌絲，似輪狀而帶皺縮，被害之果柔軟萎縮，上佈青色粉狀之孢子叢病菌初未見其侵入果肉，但可使果味變苦。

8．蒂腐病（Stem end rot）

蒂腐病由 *Diaporthe citri*（Faw.）Wolf所致在貯藏及包裝運銷之果實中發病較烈，其顯著特徵爲柔軟之棕色面積圍繞於底部或蒂部附近，如成熟採取之果被害，以手指按之每覺柔軟似革，繼之則有灰黃色澤塗蓋於棕色部份上，當此面積增大蔓及果之1/3－1/2時，其色澤即變暗棕，且果實本身亦甚覺柔韌，但非甚軟可以手指壓破者。

9．凹斑病（Peteca）

本病係一種特殊病症，利東未詳在包裝試驗之果實時常發生此病，因果殼表面陷入而有深凹斑點，初呈紫色或棕色，後變褐色病斑，組織遂乾枯皺縮而有擴大現象，表面細胞初甚正常而無任何摩擦或機械損傷痕跡，但在果皮之內凹斑之下方組織每顯乾燥，皺縮呈白色或褐色，設呈白色者則凹斑與果殼之剩餘部份色澤難分，呈褐色者則凹斑部呈暗色，蓋半透明之健全細胞蔽住褐病細胞也。設凹斑無色若水漬狀，而果皮復漸變緊縮者，則凹斑難以區分，又凹斑之形成係由果皮內部之一部細胞首先潰敗乾枯，繼之則尚見完好之外部果皮凹入，惟在果皮未凹入前果皮內面之乾枯部與外部完全切斷，後始呈現凹斑，凹斑面積柔軟易破極便於他種病菌之侵入。

10．炭疽病（Anthracnose rot）

此病由 *Gloeosporium sp.* 所致，爲害花果叶枝等部，但不如黑星病等之嚴重。其特徵爲發生深淺不一之圓形凹陷潰斑，尤以果實爲甚，致使失卻美觀，幼果時期特易受染，花芽受害每在開花前即變棕黃萎落，但如在花芽展開後受病，則花芽將在結果前脫落，如在幼果時受病不烈，則雖不至於落果亦必至使果實產生污斑，或變爲畸形。又果實生長達正常果形3/4時則對此病有免疫性，通常果實正在生長而染此病，則受病組織與果之其餘組織逐漸脫離，終乃生成瘡痂而脫落，遺留深淺不一之疤痕，此種病斑與真正瘡痂病者不同蓋因致病病菌各異也。

11．褐腐病（Gray mold）

此病由黴菌 Botrytis Cinerera 所致係貯藏及運輸病害之一施常常被侵害，但不若青黴病與

蒂腐病之烈，亦常見於果園內，由於接觸而傳播，發病初期無明顯色澤，但至後則有褐色之斑佈於表面，且易爛在頂部，蒂部或受傷部份附近，被害部在病徵生長之初甚堅硬，繼則反變鬆軟。

12. 鐮刀菌腐爛病 (Fusarirm rot)

貯藏試驗之腐果中檢有此病，但為害輕微係由 Fusarium Sp. 所致，常自蒂部開始或自傷口侵入，病斑較緩略細，外緣呈暗紫褐內部為淡褐色，甚似炭疽病菌所致之腐爛病，但在病斑中間生有粉紅色之孢子堆，曾經接種試驗其發病亦甚緩慢。

13. 黑煤病 (Black mold)

黑煤病為漳州柑橘最普遍之病害，以長泰縣南鄉之柚樹受病最烈，幾無樹不受其害，且有全樹均為病菌蓋滿，致蒼綠之樹一變而為污黑不堪，此病由 Capnodium citri及Meliola citri Sacc. 所致，其病徵為黑色絨毛狀膜覆蓋於葉、果、枝等部，但只寄生於表面不侵入組織內，主由蚜蟲，介殼蟲等分泌之蜜露而誘致寄生，故此分泌物不多時，黑徵亦僅限於一定面積內，反之分泌物甚多，則樹之葉枝果等部可全蔽以黑徵。

14. 梢枯病 (Withertip.)

此病在長泰龍溪之柑樹發生較烈，尤以長泰武安鄉之柑樹受害更甚，病樹枝梢葉片幾全枯落，顯呈禿頭現象，係 Colletotrichum Sp. 所致，其病徵為成熟枝條自先端向下逐漸枯死葉片亦漸次脫落，有時葉片枯萎極速，乃致多數枝梢枯死，大枝條在病勢甚劇之情形下亦現病態，色轉黃而葉落，同時更伴以落果現象。

15. 裾腐病 (Fcot rot)

本病在低窪濕地之柑樹發生頗烈，排水不良及粘性土壤更易發生，亦有稱之曰頸腐病 Collar rot 由 Phytophthora parasitica Dastur 所致，亦流膠病之一種，侵害幹部及根頭之樹皮，當在位於地上之下，最初病徵為小面積之樹皮朽壞，自其處流出小滴之膠，此朽壞之樹皮初若水漬狀，有時可見稀薄之膠流出，且此朽壞樹皮與其底層之木材部常有特殊之發酵氣味，後於樹皮之其他部份亦有膠流出而終致全樹死亡，此病最盛於暮春早夏時節，且雨水可沖掉其膠，及散播病菌，病部每能產生癒合組織，尤多在其上方處以阻病部之擴展，繼之老朽之樹皮碎片脫落，當此病進展甚烈時則根系及幹部周圍均罹病，且樹枝迅速下垂，葉片淡黃狹小而較之正常者暗黑且硬，但尚能結果，惟果形甚小耳，總之此病所致病徵極不規則，嚴重者得病一年即死，否則可達數年之久。

16. 膠腐病 (Gummosis)

膠腐病通常由數種真菌或其他化學性毒害及生理方面刺激所致，漳州之柑樹，柚樹均有此病，惟病原尚未確定，其特徵為樹皮龜裂，自裂口緩緩流出青白色之膠水，常往下直流形成淚痕狀，後此膠因曝露空氣中，故色暗而質硬且於裂口處積成大塊，若將蓋住膠之樹皮剝開，可見此病之發展情形，通常樹皮有膠流者，則樹皮必變色惟不深達形成層。但較老之樹皮其裂縫處之面積更大，且枯死樹皮直達木材部更因內部膠之堆積甚多，故外部樹皮漸次脫落，病勢烈時則樹於短時間內死亡，否則尚可維持數年之久。

17. 膏藥病 (Felty Fungus)

此病常由 Septobasidium pseudopedicellatum Burt 所致，長泰江南鄉之柚，龍溪管健鄉之橙受害較烈，枝幹均變污穢不堪，即因此菌生長而包圍之故，但不直接加害於樹，常由樹枝蔓延至葉柄及葉之基部等處，有淡棕色或灰色柔軟之絨氈狀物，表面光滑緻密如膜質，底部柔軟

綠化病斑。此菌只在表面生長而不侵入樹皮組織之內，據云其發生與介殼蟲之生長有關，多發生於蔭濕地區尤以內地荒林之柑樹最烈。

18. 日焦病 (Sunscald)

果實被陽光之部份先呈黃紫，後漸變乾枯之棕色大斑，此即日焦病之病徵也。復因果實大部曝露於日光中遇和暖天氣致皮殼油胞乾涸而變汚斑，受害烈時則被害細胞產生徑約 $\frac{3}{4}$－1 $\frac{1}{2}$ 吋之灰色以至黑色之疤狀組織，故果實外形極爲醜惡甚至不堪食用，幹部及枝條對此病害亦易感染。

19. 象皮病 (Buck skin)

象皮病爲特殊之果皮病害由 *I hyllocoperus oleivorus* 所致其顏色自灰色至各種棕色以及黑色等均有，橙柑受此病害時呈現紅棕色，故稱之曰 Russet Orange (棕橙樹) 柑農稱之曰象皮病，蓋其果皮失其原有光滑與橙色也。

20. 裂果病 (Split)

果實生長最旺盛或將紅熟之時，裂果病發生較多，橙柑較其他品種更易罹害，其裂開形式多爲縱裂或橫裂，據云爲生理性病害，惟常雜以數種黴菌，此次採集所得之標本曾檢得 *Alternari citri* 病菌。

21. 地衣病 (Lichen Spot)

地衣常見於柑樹幹部枝梢及葉片等部，時被誤認爲寄生病害，但非全爲寄生現象，蓋地衣僅生活於表面而自空中或其所寄生之樹皮死亡組織中取得養料，其種類很多，龍溪南靖與長泰之一部柑園其葉片滿長綠褐色圓斑之地衣，雖非眞正之寄生病害，但可妨礙柑樹之呼吸及蒸發作用，影響及柑樹之生長不良。

22. 風害 (Wind injury)

風害可致各種不同之損害，有者極易與病菌所致之病相混，其爲害普通有二種形式 (1) 因果內水分蒸發而乾枯致細胞死亡，(2) 因相對之枝條或刺互相摩擦而致機械損害。漳屬各縣柑園因管理技術欠善，且從未疏枝或剪除枯枝，故第二種風害較烈，果皮因摩擦而疤痕重重，常因此擦傷而誘致其他病害。

23. 雹害 (Hail injury)

柑橘果實時被冰雹爲害，其嚴重程度隨降雹之持續期間及冰雹之大小而異，其對於柑橘之最大威脅即爲損害正在發育期間之幼果，此損害在幼果雖不甚明顯，但至果實成熟時則有明顯之傷痕，病斑通常爲圓形小而深凹徑約 $\frac{3}{4}$－1 $\frac{1}{2}$ 吋，至老時則多爲硬裂之木栓狀組織，此硬裂組織時可脫落而餘光滑之疤痕，多位於果之一邊或頂部，龍溪之柑園亦有雹害但不甚嚴重耳。

24. 剝皮病 (Scaly bark)

此病亦爲漳柑嚴重之病害，危險性僅次於黃龍病，因其富傳染性且能促致柑死亡。長泰、龍溪及華安之翠溪等地之柑園發病亦烈，有若全園柑樹均死於此病，然以椪柑、紅橘較富感染性。

漳柑剝皮病之特徵頗似美國 Florida 之 Scaly bark 但病原尚未鑑定，其病徵初在橙柑之幹部或枝部，呈灰黃色小圓斑，樹皮亦隨之脫落，有者其直徑大達3 cm.，斑之四周雖有癒合組織形成，但中間木材部仍然顯露，此病發生烈時全部枝幹均呈剝皮現象，更因聚合而形成一圈，病主生長機能遂因之中斷而促致死亡，否則病主之生長亦呈劣態。

Phytopathology of Citrus in Changchow, Fukien.

Che-poh Chen and Shui-chen Chiu

(Summary)

The present survey was conducted by us in the autumn of 1944. The regions visited are the following districts of southern Fnkien such as Lung-chi, Chang-tai, Nan-chien, Hai-ten and Hua-an.

The general condition of the Citrus culture in the area surveyed is described. The description includes the planting area, varieties of Citrus trees, orchard management, transportation, and insect pests.

Altogether twenty four kinds of diseases were investigated. These diseases together with their causative organisms are listed as follows:

Disease	Causative organism
Tip-Chlorosis	unknown
Black spot	*Phoma citricarpa* Mc. Nlp.
Melanose	*Diaporthe citri* (Faw) Wolf.
Scab	*Sphaceloma fawcetti* Tenkins
Canker	*Phytomonas citri* (Hasse)
Blue contact mold	*Penicellium italicum* Wehmer
Green mold	*Penicellium digitatum* Sacc.
Stem end rot	*Diaporthe citri* (Faw) Wold
Peteca	unknown
Anthracnase rot	*Gloeosporium* sp.
Gray mold	*Botrytis cinerera*
Fusarium rot	*Fusarium* sp.
Black mold	*Capnodium citri* and *Meliola citri* Sacc.
Wither-tip	*Colletotrichum* sp.
Foot rot	*Phytophthora parasitica*
Gummosis	undetermined
Felty Fungus	*Septobasisium pseudopedicellatum* Burt
Back skin	*Phyllocoperus oleivorus*
Split	*Alternaria citri*
Wind injury	due to physical injury

Hail injury	due to physical injury
Scaly bark	unknown
Sun scald	due to physical injury
Lichen spot	Lichen

二十八星瓢蟲研究初報

林 伯 欣

A Study Of The 28-spotted Ladybird, Epilachna vigintioctomaculata Motsch. (A Preliminary Report)

by

Pe-Hsin Lin

I. 前　言

以植物性食物為主要營養料，而對農作物有危害之瓢蟲科（Fam. Coccinallidae）昆蟲，首推 *Epilachna* 一屬。此屬昆蟲，在國內經發現曾載之於文籍者，根據傅文英教授 1933 年所編著之 „A Check List of the Coccinallidae of China" 一文，計有 *E. acuta* Ws.; *E. admirabilis* Crotch.; ……*E. vigintioctopunctata* Fab. 等十九種及三變種。此類瓢蟲中，以二十八星瓢蟲（*E. 28-maculata* Motsch.）一種，分佈最廣，南起海南島，北達東三省，都經普遍發現；惟於江南諸省，尤為猖獗，由春暖直至秋深，舉凡山野田園，倘有茄科植物生長之處，每見大量發生，殊堪惹人注意也！筆者二十七年四月至同年九月在江西之泰和、贛縣、遂川與萬安；二十八年四月至同年十月在廣西之宜山與柳州；二十九年四月至三十年六月在[illegible]南之[illegible]與[illegible]；三十年十月至三十一年十一月在福建之沙縣。及三十三年四月至三十四年四月在福建之永安，曾先後着手進行此蟲之研究工作，惜以環境不佳，未能繼續工作，致無完滿結果。茲將已知之形態大略，食害範圍，以及生活、習性等，臚列於後，或可一供同好之參考。至若生態學，遺傳學，……等諸種問題，暨其有效防治法，日後當另文報告之。

考察此蟲之生活史時，在沙、永兩地所進行之室內飼育工作，前後承本所吳[illegible]君，暨王玉如小姐，努力協助，筆者特誌此以表謝忱！

II. 形 態 概 述

成蟲　體半球形，赤褐色，密被黃褐色細毛。長短大小，變化頗巨，每以營養、氣候（尤以

氣溫）以及遺傳諸因子之關係，發生顯著之差異，通常長5.0—6.6mm.，平均約5.7mm.；闊4.0—5.3mm.，平均約4.6mm.，受同一遺傳及環境因子支配下所發生之蟲體，雌者較雄者爲長大。頭扁而短小，平時大部份隱藏於前胸之下。觸角十一節，近棍棒狀，柄節發達，梗節次之，鞭節末端三節膨爲三大。複眼黑色，位於頭兩側。口器咀嚼式，大顎不十分發達。前胸背板多具有黑斑六個，對稱排列，或有當中相隣兩個聯合成一，而呈五個者，又有少數全部隱沒不顯，甚至完全消失者。每一翅鞘上，普通具有大小不同之黑點十四個，故有二十八星瓢蟲之名。此等黑點，多作2·3·3·3·2·1或3·4·3·3·1之排列；惟時受遺傳以及氣候因子（尤以氣溫）之影響，而發生巨大之變化，其位於翅背中央隆起處者常消失者，每有前後或左右合連之趨勢，又生長於黃岡之宜山、柳州等地，兩翅鞘上之黑點，更有聯合成帶者，是以有二十六星，二十二星，十八星，十二星，……甚或全部連結而呈一塊大黑斑之現象。腹部在腹面能見者六節，雌者最後一節腹板中央之裂痕，較雄者爲明顯。足短而小，適於步行。

卵 — 長紡錘形，頂端尖而底面鈍，近底面約三分之一處，最爲膨大。表面光滑，長1.1—1.4mm.，平均約1.3mm.。初產時乳黃色，後變爲深黃色，將孵化時，則近淡黃褐色或灰黃色。通常成塊豎立於寄主植物葉之下表（如於寄主植物葉之上表及莖部，或與其鄰接叢生之野草莖葉上，日光不能直射處，間亦可以發現卵塊之存在）。每塊中，卵之數目無定，最少5—7粒，最多95—98粒，普通爲30粒左右。

幼蟲 — 毛蟲式，作紡錘形，背部隆起。初孵化者乳黃色，攝食之後，漸變爲淡黃色，至第四齡呈蒼白色。充分成長時，體長6.5—8.0mm.，平均約7.0mm.；闊2.5—3.1mm.平均約2.8mm。頭部細小，兩側各着生短小多節之觸角一條，近基部上端，各有小眼三對。口器亦不十分發達，大顎尖端黑色。胴部能見者十二節，胸足纖細。1—3胴節之腹面，各具簡單之胸足一對，其跗節連結爲一，末端各生黑色之爪一個。第一胴節（或第一胸節）與第十及第十一胴節（或7、8腹節）之背板上，各具長刺四條，第二至第九胴節（或2—3胸節及1—6腹節）之背板上，各具長刺六條，各刺分枝甚多，枝末微彎而尖銳，在各背板正中，橫列爲一行，基部有淡黑色環紋。其在1—3胴節背板中央相隣之兩刺，距離較遠，在其他各節上者，則距離較近。最末胴節（即腹部第十節），變成圓柱之肉質突起，形成吸盤狀構造，其上不時分泌白色黏液，以爲行走或倒懸身體之助，並爲固着身體之用。幼蟲充分長成後，經過短期時間，即以最後胴節黏着於寄主或他物上，縮體彎背，形成前蛹，其體長5.2—6.2mm.，平均約5.6mm.；闊3.0—4.0mm.，平均約3.5mm.。

蛹 — 裸蛹式，表面柔軟，疏被褐色細毛。外無絲繭或其他包被物。近扁卵圓形，長4.0—6.0mm.，平均約5.5mm.；闊3.6—5.2mm.，平均約4.8mm.。初蛹化時乳白色，後變爲淡黃色。腹尾由幼蟲末次蛻殼所包被，藉之固着於植物之上。此時成蟲所有之體軀暨其附屬器，皆已顯現：頭部下垂，前胸背板露出，翅貫緊貼體之兩側，前翅末端彎曲，由此可以微見後翅之一部。六足游離，屈曲於腹面。腹部背板顯明，其兩旁近翅處，常有褐色之小斑現焉。

III. 食 害 範 圍

二十八星瓢蟲之食害範圍，根據國內外參攷文獻上所載，計有下列各植物：

（一） 茄科 Solanaceae：—

1. 茄子 *Solanum melengena* L.

2．馬鈴薯 *S. tuberosum* L.

3．龍葵 *S. nigrum* L.

4．酸漿 *Physalis Alkekengi* L.

5．番椒 *Capsicum longum* L.

6．辣椒 *C. annuum* L.

（以上各植物，除葉片外，莖皮及果亦可被其食害）

（二） 葫蘆科 Cucurbitaceae：——

7．南瓜 *Cucurbita pepo* L.

8．西瓜 *Citrullus vulgaris* Schrad.

9．苦瓜 *Momordica charantia* L.

10．絲瓜 *Luffa cylindrica* Roem.

11．甜瓜 *Cucumis melo* L.

12．胡瓜 *C. sativus* L.

（三） 豆科 Papillionaceae：——

13．落花生 *Arachis hypogaea* L.

（四） 旋花科 Convolvulaceae：——

14．番薯 *Ipomoea Batatas* Poir.

（五） 無患子科 Sapindaceae：——

15．荔枝 *Litchi chinensis* Sonn.

（六） 薔薇科 Rosaceae：——

16．中國梨 *Pyrus sinensis* Lindl.

（以上植物，均係葉部被其食害）

惟筆者曾年來在上述各地，自野外普通調查，與室內分別飼育結果，認爲僅有大部份之茄科植物，係其生活上所需要之營養料，若以此等植物分別單獨飼養之，皆可完成其全部之生活史也。此等植物即：

1.茄屬 *Solanum* 中，計有：—(1)茄子；(2)馬鈴薯；(3)龍葵；(4)紅絲線 *S. biflorum* Lour.；(5)水茄 *S. verbascifolium* L.；(6)蜀羊泉 *S. lyratum* Thunb.；(7)白英 *S. dulcamara* L.；(8)冬珊瑚 *S. capsicastrum* Link.；(9) *S. aculeatissimum* Jacqu.。

2.番茄屬 *Lycopersicum* 中，有：—(10)番茄 *L. esculentum* Mill.。

3.酸漿屬 *Physalis* 中，計有：—(11) 酸漿；(12) 苦蘵 *Ph. angulata* L.；(13) *Ph. minima* L.。

4.枸杞屬 *Licium*中，有：—(14) 枸杞 *L. chinense* L.

5.曼陀羅花屬 *Datura* 中，計有：—(15) 曼陀羅花 *D. alba* Nees.；(16) 野生曼陀羅花 *D. Tatula* L.；(17) *D. Metel* L.。

其中尤以龍葵、紅絲線、水茄、茄子、馬鈴薯、白英、蜀羊泉、酸漿、苦蘵、枸杞、、曼陀羅花、……等最爲所嗜。至於番椒與辣椒，在野外田園間，絕少發現被之食害，僅僅於龍葵、苦蘵、茄子、……等，與其鄰接混雜之處，可見其葉片上，偶有二、三被害之痕跡而已耳。如於生活狀

蟲之寄主，在室內以番椒或煙草葉片飼養之，不但不能完成一世代，而且幼蟲多則三日，少僅一日多，成蟲多則七、八日，少則四、五日，必都飢餓而死。南瓜、西瓜、……等葫蘆科植物，與落花生、番薯、荔枝、梨等葉片，根本不能嚙食，前人錄於著述中，所以記載之原因，筆者認為必屬下列兩點錯誤：

第一、種類上認識錯誤　如大二十八星瓢蟲（*E. niponica* Lew.）除食害一部份茄科植物外，尚能害及胡瓜、甜瓜、……與諸蔬等（根據日人田邊忠一及高橋陽氏調查結果）；又如二十八點瓢蟲（*E. vigintioctopunctata* Fab.(?)）除食害黃豆，豇豆、……等外，尚嚙食小麥之花藥（根據筆者在廣西宜山東門外田間觀察所得），是則食害南瓜、西瓜、……荔枝、梨等，或係其他鞘翅上亦具有二十八個星點之瓢蟲矣。

第二、機會上觀察錯誤　當二十八星瓢蟲大形猖獗結果，野外龍葵、苦蘵、枸杞等葉片，被摧食光以後，或田間茄子、番茄等葉部，生長全皆過於粗老之時，於是在此區域中之瓢蟲成虫，不得已而移害一部份之番椒或辣椒，然數日後不行遷徙覓食，不久必歸死亡，是為偶爾之事故，不宜視作平常之實情。

二十八星瓢虫之幼虫與成虫，除食害上述各寄主植物之葉片外，亦可害及花瓣、萼片與細嫩之果皮。倘使葉花俱盡，尚能食害嫩莖。如單獨用花瓣、萼片或嫩莖飼養其初孵出之幼虫，都能生長發育成成虫，特所需時間，較飼以葉片者為長久。由此觀之，則本虫實不只限於食害寄主植物之葉部明也。

IV. 生　活　經　過

二十八星瓢虫，一年發生世代之數，每因環境而生鉅大之變化；雖然，自三十年十一月下旬至三十一年十一月上旬在沙縣，又三十三年三月下旬至三十四年三月下旬在永安，橫經一年之觀察，證實，如有多數發生六世代，而有少數發生五世代，則在同一環境下，其生活史亦有顯著之差異矣。

此虫之發生至無規則，往往在同一地點與同一時間內，可以發現其卵、幼虫、蛹及成虫各時期。又成虫之壽命，除越冬者不計外，或有延長至三個月以上，且仍能繼續交尾產卵，生殖子孫，故於第二或第三子代完成後，而原有之成虫，可以與之同時生存繁殖，因產卵前後相距甚遠，遂發生世代或六或五之差別，當屬必然之現象也。茲根據上述在沙、永兩地室內飼育，並參照野外觀察結果，以各時期在自然界中之盛發時間為標準，採用 Rhümbler 氏完全變態昆虫之生活式，表明其生活史如下：

1. 年生六代者：——

$4^{am}-4^{mp}5^{a}$

$5^{a}+5$ （ $5^{p}6^{a}-6^{am}$

$6^{m}+6^{p}7^{a}$ （ $7^{am}-7^{mp}$

$7^{p}+7^{p}8^{a}$ （ $8^{am}-8$

$8^{p}9^{a}+9^{am}$ （ $9^{mp}-9^{mp}10^{a}$

$9^{p}10^{a}+10$ （ $10-10^{mp}$

$10^{p}11^{a}+11^{am},3^{p}4^{a}$

2. 年生五世代者一：

$$\frac{4^{mp}-4^{p}5^{a}}{5^{m}+5^{p}6^{a}}\ \frac{5^{p}6^{a}-6^{am}}{6^{mp}+6^{p}7^{a}}\ \frac{7^{am}-7}{7^{p}+8^{am}}\ \frac{8^{mp}-8^{p}9^{a}}{9^{mp}+9^{p}10^{a}}\ \frac{10^{am}-10^{mp}}{10^{p}11^{a}+11^{am},3^{p}4^{a}}$$

〔註〕(1)一橫線代表一世代

(2)橫線上方減號左邊代表卵期，右邊代表幼蟲期；橫線下方加號左邊代表蛹期，右邊代表成蟲期，例如$\frac{\text{卵}-\text{幼蟲}}{\text{蛹}+\text{成蟲}}$。

(3)式中3、4、5……等代表三、四、五……等月份。

(4)a代表上旬；m代表中旬；p代表下旬。

(5)式中之「，」稱為越冬點，表示該蟲至此開始越冬。

至於各世代中之卵、幼蟲與蛹各時期經過約計日數，以及成蟲之壽命，並各世代由卵至成蟲所需之時間，每因氣溫、氣濕而生巨大之差異。茲將在沙、永兩地觀察結果，列表如下：

年生六世代者

世代 經過約計日數 時期	第一	第二	第三	第四	第五	第六
卵期	6.5—8.0	4.0—5.5	3.5—4.5	3.0—4.0	4.0—5.5	5.0—6.0
幼蟲期	22—23	18—22	13—16	13—15	16—18	16—18
蛹期	4.5—5.0	3.5—4.5	2.5—4.0	3.0—4.0	3.0—4.0	4.0 5.0
成蟲壽命	50—85	45—80	40—70	45—85	60—95	180—200
由卵至成蟲	32.5—36.0	25.5 32.0	19.0—24.5	19.0—23.0	23.0—27.5	25.0—29.0

年生五世代者

世代 經過約計日數 時期	第一	第二	第三	第四	第五
卵期	6.5—8.0	4.0—5.5	3.5—4.5	3.0—4.0	4.0—5.5
幼蟲期	22—23	18—22	13—16	14—16	16—18
蛹期	4.0—5.0	3.5—4.5	3.0—4.0	3.0—4.0	4.0—5.0
成蟲壽命	50—85	45—80	40—70	55—85	180—200
由卵至成蟲	32.5—36.0	25.5—32.0	19.5—24.5	20.0—24.0	24.5—28.5

（註） 1.表中經過約計日數，係根據室內飼育結果所取得之衆數(Mode)。

2.最後一代之成虫，即越冬之成虫，其壽命特長。

幼虫共有四齡，各齡經過日數，亦受氣候及營養之影響，發生顯著之差異。茲將其處於普通狀況下，所得約計之數，列表如次：

齡　期	第一齡	第二齡	第三齡	第四齡	
				活動期	前蛹期
所經日數	3.0—5.0	2.5—4.5	2.0—4.0	4.0—5.0	1.5 4.0

V. 習　性

一、成虫之習性

越冬之成虫，至翌年三月下旬或四月上旬春暖時，復行出現。此時茄子、蕃茄、………等多未栽培，乃專息於龍葵、苦蘵、………等野生茄科植物上，而食害之，俟後始轉移而爲害其他農作物。

成虫攝食時，先以足立定於被害物上，然後伸長頭，由左到右或由右到左嚼食之。食罷，稍縮頭部復食，於是嚼成弧綫三、五條，直至頭部不能再縮，遂倒退體軀，或更換地位，繼續攝食。成虫與幼虫，其口器既均不甚强大，故嚼食葉片或花瓣，絕少洞穿至他一面者，而脈道比較粗糙，遂多殘留，因之被害部分，能形成許多有規則之小凹縫，縫中細絲（即小葉脈）顯見，一望而知。係受其害也。

初羽化之成虫，通常須經三小時以上，方能開始攝食。成虫攝食不分晝夜，惟於清晴之白晝，食量往往增加；而於氣溫過低或高，風雨交加，或强烈陽光照及之時，可以阻礙其活動，食慾亦即隨之減退。

成虫除食寄主植物外，尚嘗有與其他瓢虫相同之食卵習性。不少♀虫，每於產畢一堆之卵，即轉向其體，嚼食其一部。又成虫於饑餓之際，不僅可以食卵，且亦嚙蛹，甚至有自相殘食者，殘食之法，先爬行至被害者體後，以頭部向其兩翅鞘縫隙處前後推摩，令之開張，然後趁勢咬其體背，逐漸嚼食，終剩空殼。

成虫之羽化，並無定時，羽化後通常須經三日以上，始能交配（當生育旺盛，而♂虫羽化已久，初羽化之♀虫，亦有少數被迫而行交配之現象）。交配時間，短僅二、三十分鐘，長則延長至五、六小時以上。雌、雄一生交配多數次。♀虫交配後，約經五日以上，遂開始斷續產卵。產卵多在上午八、九小時至下午五、六小時，每由多數粒直立相接成塊，附着於寄主植物葉之下表，或與寄主植物緊靠之他物上蔭蔽處，蓋卵不能受陽光長時間之照射，且新孵化之幼虫，活動力較弱，多數只能於孵化所在，攝取食物，而母虫產卵，乃有選擇位置之必要矣。

氣溫25—28°C.，氣濕80—85%R.H.之間，乃成虫生活最適時期，舉凡攝食、遷徙、交配、產卵、……等，行之最多，故於六、七、八與九等四個月中，當雨後新晴之時，其食害程度與繁殖數量，均較平常爲顯著。

成虫具背地與趨光之習性，惟不宜受强烈陽光之直接照射，故常棲息於明亮處，寄主植物上

部葉之底面。又具假死性，一受驚動，立即縮足下墜，此時由其六足腿節連接脛節處之末端小孔門，每每容易泌出黃色、特臭、鹼性之排拒性血液，藉之保護其體。下墜後如落地面或他物上，必然腹底朝天，須歷一、二分鐘乃至三、四分鐘，始伸足張翅，翻轉體軀，然後向上爬行。

成虫雖具有發達之後翅，但不好飛翔，而連續飛翔之時間，亦欠長久。遇食料缺乏之際，僅有一部份於短期內遷徙覓食，他則周圍爬動，非至萬不得已，不致展翅遠飛。

最末一代之成虫，至十一月上、中旬，氣溫降低達 18°C. 左右，遂蟄居於雜草、叢上、老樹皮裂縫之內，或籬笆、牆壁等間隙中越冬，此時因風、雨、霜、雪寒冷之侵襲，以及其他動物之戕害，死亡甚多，其死亡率可高達50%以上。

成虫之壽命，長短不一，在自然環境下，最短爲四、五十日，最長爲二百日左右；雖然，壽命之長短，每與活動力之大小成反比，故於六至九等四個月中，成蟲之壽命較短，而於十一月上、中旬以後，越冬者則較長也。

二、幼虫之習性

在卵中業已發育完成之幼蟲，漸漸咬破卵頂而孵出。孵化時刻，早晚無定，普通多在上午5—7小時之間。所費時間，每因溫濕度之大小，而有增減，然一般須經10—15分鐘。同一卵堆中之卵，多數在同一時刻內整齊孵出，僅有少數前後相差，達五小時以上者。至於卵之孵化率，通常爲55—100%，平均約86%。

初孵化之幼虫，設非食料缺乏，皆不甚移動。幾乎統就棄殼附近，咬葉取食；稍稍成長（第二齡或第三齡），始次第分散至他處爲害。其攝食方法及寄主植物之被害狀況，與成虫相若，惟成虫最初伸長頭部，而幼虫則伸長體軀之各節，故食害面積，多數較大。

幼蟲亦具食卵並食蛹之習性，但在普通情形下，不及成蟲之劇烈耳。

幼蟲更不宜受强烈日光之直接照射，故非至夜晚或陰晦之時，皆潛息於寄主植物葉之底面，或其他蔭蔽處。

幼蟲前後蛻皮三次，始可完全成長。已達最後齡期之幼蟲，經四、五日，即停止攝食，在原寄主葉之表面或底面，莖上或雜草、他物上，由尾端分泌之粘液，多數倒懸，少數斜懸或橫向，固着其體，曲背、縮首，呈靜止狀態之前蛹，經一、二日乃至三、四日，即蛻皮蛹化。

VI. Abstract

The 28-spotted ladybird, *Epilachna vigintioctomaculata* Motsch., is a herbiverous beetle belonging to the fam. Coocinallidae. Its distribution in China is exceedingly wide, especially in the provinces south of the Yangize. The present investigation aims to give an account of its morphology, life history and habits as well as its injury upon different species of the host-plants.

1. The body of an adult ladybird is semispherical, being convex dorsally. It is crimson brown in color. The antenna is clavate with 11 segments. On each elytron there are 14 black spots of different sizes. These spots are arranged in 6 or 5 rows according to the pattern 2·3·3·3·2·1 or 3·4·3·3·1. Due to the influence of the heredity and environment it happens that these spots may combine together or may reduce.

2. The eggs are spindle-shaped, smooth, and yellow in color, and are usually enc-

losed in an egg-mass. They are fastened on one end to the undersides of the leaves. The average number of eggs in each mass is about 30.

3. The eruciform and spindle-shaped larvae are milk yellow in color when they first hatch, then they become light yellow and finally turn into pale white. The terga of each trunk segment possess long, branching black-tipped spines, which on the lst., 10th. and llth. segments are only 4 in number, while those on the 2nd. to 9th. segments are 6. The last trunk segment becomes the fleshly projection, secreting white fluid for the purpose of helping their walking or hanging up their bodies. When growth is completed, the larvae cement the hind part of their abdomens to the host plants or other things and form prepupae.

4. The pupae, libera, oval, soft in surface, are milk white or light yellow in color. The ends of their abdomens are clothed by the last larval skins.

5. In the present investigation it has been found that this particular species of ladybird can only injure the plants belonging to the most, but not all of the genera of the fam. Solanaceae. While contrary to what have been reported by the former workers, they have been found not to attack those plants belonging to the families Cucurbitaceae, Papillionaceae and others. The following species are their optimum host-plants —— *Solanum nigrum*; *S. biflorum*; *S. verbascifolium*; *S. melongena*; *S. teberosum*; *Physalis Alkekengi*; *Ph. minima*; *Licium chinense*; *Datura alba*; etc.

6. The life of the adult and the duration of the period of its oviposition are rather long, lasting over 3 months. In Sha-hsien and Yung-an, although they are living under the same environment it happens that there is a difference of 6 and 5 generations in a year.

7. The periods of the 4 stages in the life history are inversely proportional to the temperature. The egg stage takes about 3–8 days, the larval stage, about 13–23 days, the pupal stage, about 3—5 days, and the life of the adult lasts about 40—95 days. Those adults which pass thriugh the winter live about 180—200 days. The time from egg to adult occupies about 19—32 days.

8. The mouth-parts of the adults and larvae are not very strong; therefore, when they are chewing the leaves or petals, they rarely can penetrate the other sides of them. After their attack there will be a number of small and regular concave lines on the leaves or petals.

9. Both the adults and larvae are cannibalistic, eating or consuming the egg and pupa of other individuals. The adults, when they are hungry, will attack their companions.

10. There is no definite time for the adults to emerge. After a few days, they begin to copulate. More then 5 days after their copulation, they, then, begin to lay

eggs.

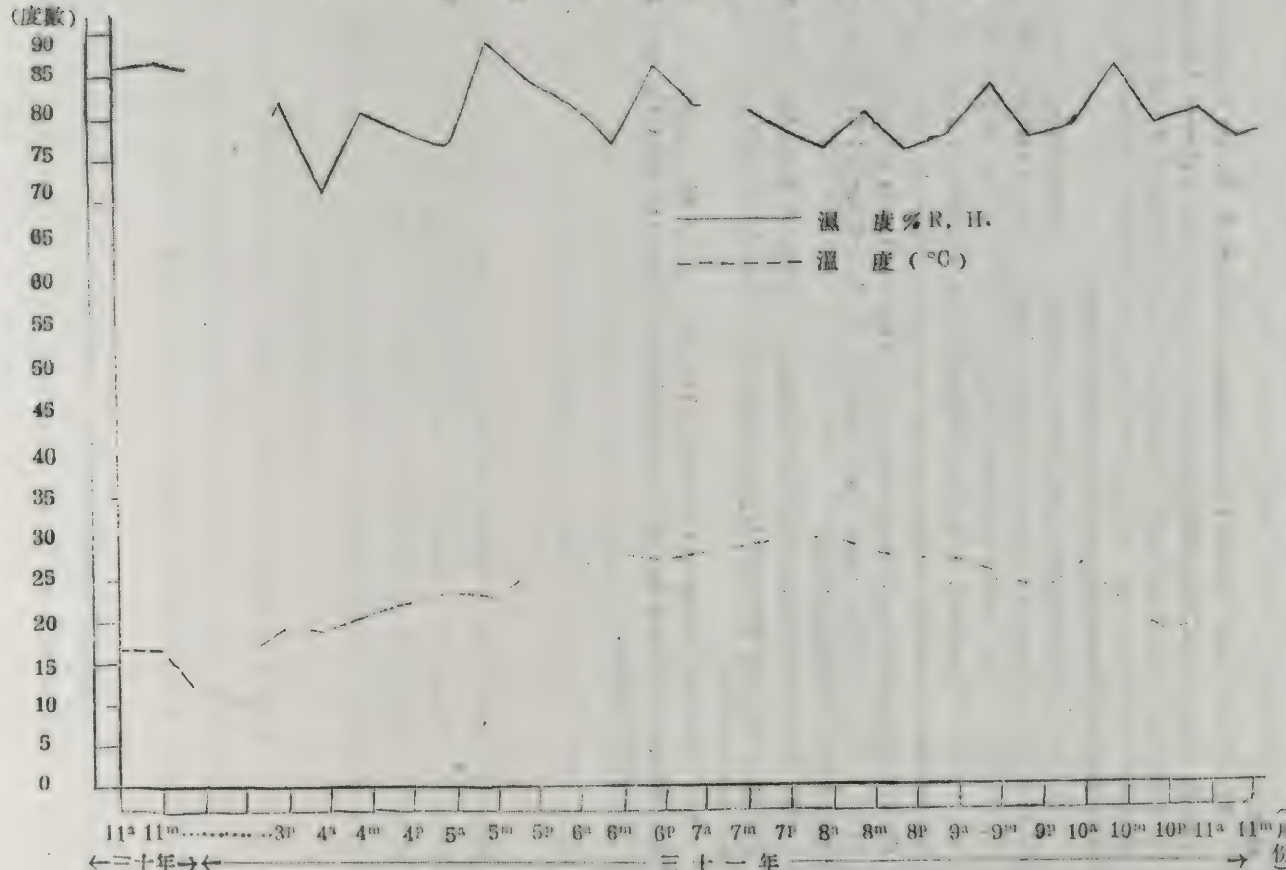
11. Temperature 25−28° C. and humidity 80—85% R. H. are suitable to the activity of the adults. They dislike flying. As soon as they are frightened they present the appearence of feigning death, shrinking their legs and falling to the ground. Sometimes from the ends of the femora of the 6 legs, the yellowish, odorous and alkaline blood may be secreted acting as the repellent substance.

12. In the beginning or middle of November, when the temperature is descending to about 18° C., the adults of the last generation begin to hide themselves in the weeds, the loose soil, the cracks of the wall, fence or barks of the tree to pass their winter. Up to the next year, in the end of March or the beginning of April, when the temperature is ascending to about 19° C., they appear again. At first, they live on the wild plants—such as Solanum nigrum; S. biflorum ; Physalis minima ; Licium chinense ; etc., then they spread their attack on the S. melongena ; S. tuberosum ; Lycopersicum esculentum ; etc.

13. There is no definite time for the larvae to hatch. At first, they take their food by groups near the places of the egg-mass. After they become more or less mature, they scatter around.

14. There are 3 molts and 4 instars. The larvae of the 4th. instar, in the last 2—4 days, stop to fetch food, fix and shrink their bodies, and form the quiet and humpbacked prepupae.

附圖一　民國三十年十一月上中旬暨三十一年三月下旬至十一月中旬
沙縣氣溫氣濕指示圖



原书缺页

原书缺页

天蠶蛾之形態習性及生活史研究

陳　瀅

Stuoties on the Morphology, Habitats, and Life History of saturnia pyretorum Westwood

Chen Ying

一、引　言

天蠶蛾亦稱樟蠶，為生於樟、楓等樹上。成熟幼蟲體內之絲腺浸於醋酸中，拉之，可成長六、七尺之絲，入水無影，堅韌不斷，為著名之釣魚絲；其經精製者，大小一致，表面平滑，無吸收力，適供外科縫合傷口之用。其繭經脫膠漂化染色後，可織呢絨，不亞於羊毛製品。我國利用天蠶絲之歷史已有八十餘年。粵、桂、贛、湘各省每年均有產品，惟吾國鮮有人注意者，任其自然生長，不[illegible]，且成為森林害蟲，[illegible]。[illegible]，有關於農村[illegible]大。作者於[illegible]縣境楓樹上發現幼蟲頗多，因引起研究興趣，經將所得結果，縷述於下，以供農業界人士之參考。

二、分類及分佈

天蠶蛾屬於鱗翅目，蛾亞目，天蠶蛾科，學名為 *Saturnia pyretorum* Westwood. 分佈於粵、桂、閩、贛、湘、海南島及台灣（係輸出）。

三、各期形態及習性

1. 卵

卵略呈長方形，長為二·五毫米，闊一·八毫米，厚一毫米。殼硬，初產者為乳白色，而有黃赤色斑點，將孵化時，則呈淺灰色。

在自然環境下，卵多產於寄主樹枝上，黏積成塊，係單層排列，間亦有重疊者。每塊之卵數自數十個以至百餘個不等，其上方均有鱗毛密植而覆之，偶觀之，不知其內有卵者。

同時所產之卵，其孵化期甚為一致。卵之孵化率甚高，為百分之九十八。孵化時，幼蟲嚙食

上端之卵殼而出，而頭殼及體毛大部分尚屬完整。

2. 幼　蟲

第一齡幼蟲——初孵化之幼蟲，長平均爲五・二毫米，頭部最闊，平均爲一毫米。胴部各節，次第變小，但彼此相差甚微。頭部及胴部各節之背面及左右兩側，均呈黑褐色，且各節均有白色及紅黃色透明點疏佈。頭部有疏纖毛，色赤褐。第一胸節背面有四簇纖毛，每簇約有二、三條，色赤褐，其基部突起，有透明點。此後直至末節，各節之背面，有兩簇纖毛，每簇約有七、八條，色赤褐，其基部突起較大，亦有透明點，口器、腹面及三對胸足，均呈黑褐色，且有淡綠色之透明部分。各足之尖端有爪，色赤褐。腹足四對及尾足一對均呈淡黃綠色而透明。

幼蟲初孵化時，羣集於卵塊之周圍，數小時後，始各自散開而覓食。孵化後之第七、八兩日爲第一次脫皮期。在將脫皮前，卽停止取食，離開飼料，爬至一處，吐絲於身體之前後左右以穩定其身，體漸縮短膨脹，約歷一日，卽行脫皮。

第二齡幼虫——第二次脫皮後之幼虫，長平均爲一二・一毫米，最闊處一・九毫米。頭部最大，胴部各節次第變小，但彼此相差甚微。頭部呈黑褐色，纖毛短，色白。第一胸節直至末節，各節之背及左右兩側均呈赤褐色，各節之纖毛基部，形成突起，色皆黃赤而透明。第一及第二胸節之纖毛色白，而第二胸節背面之突起，各具二條特長之白色纖毛。第十二節及末節之纖毛亦白色，而第十二節背面之突起亦有四條特長之白色纖毛。第三胸節至第十一節背面突起之纖毛，粗而短，色黃赤，而兩側之纖毛，則細而長，色白。臀板爲黑褐色。口器及胸足呈黑褐色，腹足及尾足呈黃赤色而透明。

第三齡幼虫——第二次脫皮後之幼虫，長平均爲二〇・一毫米，最闊處二・八毫米。自首至尾各節幾等大。頭部呈淡黃色，纖毛基部之突起爲鮮黃色。第一、二胸節及第十二節之纖毛呈白色外，另具黃赤色之短刺，而第二胸節之背面兩突起及第十二節之背面與左右四突起，各突起均具二條特長之白色纖毛。第三胸節至第十一節之背面兩突起祇具黃赤色之短刺，而其左右突起除具黃色短刺外，尚有白纖毛。背線、亞背線、氣孔線及氣孔均呈藍黑色，而氣孔與亞背線間，尚有藍黑色小點。口器、腹面及胸足爲灰褐色。腹足爲灰色。尾足爲淡黃色。臀板有藍黑色點。尾足外側有藍黑塊。

第四齡幼蟲——第三次脫皮後之幼蟲，長平均爲二八毫米，最闊處四・一毫米。頭部及第一胸節較小，其餘各節幾等大。頭部呈淡黃色，有黑色斑點，纖毛短，色白。背線及亞背線爲綠色，其餘之背面及左右兩側（除背線及亞背線外）幾爲各纖毛突起所佔有，呈淡黃色。口器、腹面及胸足爲灰黑色。腹足及尾足爲淡黃色。臀板有藍黑色點。尾足外側有藍黑塊。

第五齡幼蟲——第四次脫皮後之幼蟲，長平均爲三七毫米，最闊處七毫米。其形態及色彩均與第四齡同。

第六齡幼蟲——第五次脫皮後之幼蟲，長平均爲六〇・二毫米，最闊處八毫米。口器爲黑褐色，胸足、腹足及尾足爲淡黃色。腹面爲綠色而帶微黃。餘與第四齡同。

成熟之幼蟲，長平均爲九五毫米，最闊處一〇・一毫米。身體次第縮短而膨脹，略呈透明，停止取食，爬至一處，吐絲作繭，化蛹其中。

在自然環境下，成熟幼蟲每於上午十一時至下午二時間，循枝而幹，直向下爬，尋覓化蛹處所，常於樹幹之縫隙間，吐絲作繭而化蛹，間亦有爬至寄主附近之雜木上化蛹者。

或蛻皮四次或五次，二者各佔半數。蛻皮四次之幼蟲，概皆先行化蛹。幼蟲蛻皮之次數，與成蟲之性別無關，惟雌蟲之蛹期歷時較雄蟲爲長，而其幼蟲期歷時則較雄蟲爲短。

3. 蛹

繭爲長橢圓形，色多淡黃，間亦有灰白及灰褐者。最大之繭，長平均爲六五毫米，最闊處二五毫米。最小之繭，長平均爲六〇毫米，最闊處二〇・一毫米。大小平均，長爲六二・三毫米，最闊處二三毫米。繭之較尖一端，其口疏鬆，不作纏結，而留一口，羽化之成蟲，即自此鑽出。

幼蟲化蛹繭中，蛹爲長橢圓形，前端鈍圓，後端較尖，長平均爲三二・八毫米，最闊處一〇・五毫米。全體除吻之基部爲淡黃色外，其餘部分均作紫褐色。其環節自背面觀之，可見者爲十個，自腹面觀之，則爲六個。

4. 成蟲

成蟲之雌者展翅平均爲九一・五毫米，體長平均爲三四・五毫米；雄者展翅平均爲七七・五毫米，體長平均爲二八・二毫米。前翅之鱗毛爲褐色，亞外緣爲黑褐色，環狀紋甚顯著，邊緣爲暗黑色，中央爲黑褐色，外橫線爲黑褐色，翅基亦爲黑褐色。後翅除環狀紋較小，其周圍爲灰白色而帶微紅，及翅基亦爲灰白色而帶微紅外，餘與前翅同。

全身被有絨毛，頭部除觸角爲淡黃色，複眼爲黑褐色外，其餘部分爲棕褐色。頸板及肩板爲灰白色而帶微紅。胸部之背腹面及足均爲棕褐色。腹部在雄蟲爲棕褐色及灰白色而帶微紅之絨毛相間而生，在雌蟲其前半段絨毛之色彩與雄蟲同，而後半段則全爲棕褐色。

雄蟲與雌蟲區別甚易，其不同之點如下：

1. 雄蟲
   - a.身呈圓錐形，胸部大，而腹部次第尖小。
   - b.腹部絨毛之色彩爲灰白而帶微紅與棕褐相間而生者。
   - c.觸角爲羽狀，較雌蟲約闊四倍。
2. 雌蟲
   - a.身呈圓筒狀，胸部與腹部前段同大，而腹部後段則較大。
   - b.腹部絨毛之色彩前半段爲灰白而帶微紅與棕褐相間而生，而後半段則全爲棕褐者。
   - c.觸角爲羽狀，較雄蟲約狹四倍。

成蟲初羽化時，即排出多量之褐液，翅捲縮，後則徐徐展開，而豎立，終則下垂。日中靜伏不動，交配產卵，多在夜間。羽化後二十四小時內，即可產卵。一雌蟲產卵最多者爲五〇一粒；最少者爲九三粒；平均爲二六四粒，成蟲壽命最長者爲二十日；最短者爲七日；平均爲十二日。而雌蟲之壽命概較雄蟲爲長。

四、生活年史

作者於三十一年五月，自野外樟樹，採集多數幼蟲，育於籠中，至六月間，先後作繭化蛹，直至三十二年二月中旬始羽化。取該年二月十二日所產之卵，作此蟲之生活史研究，至三十三年二月完成一世代。故此蟲每年僅能發生一代。茲將所得結果，列表於下：

生活年史表

號數	产卵期	孵化期	蛹化期	羽化期	死亡期	卵期歷時	幼蟲期歷時	蛹期歷時	成蟲期歷時	一代歷時	性別
1	二月十二日	三月十六日	五月廿二日	一月廿[illegible]日	二月四日	32日	67日	246日	12日	357日	雌
2	同上	同上	五月廿六日	一月廿八日	二月十二日	同上	71日	247日	15日	365日	雌
4	同上	同上	五月廿四日	一月廿[illegible]日	二月十日	同上	[illegible]	[illegible]	18日	[illegible]	[illegible]
5	同上	同上	五月十日	[illegible]	[illegible]	同上	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
6	同上	同上	五月十六日	一月廿[illegible]日	[illegible]	同上	[illegible]	252日	[illegible]	[illegible]	[illegible]
7	同上	同上	五月五日	一月廿一日	二月八日	同上	50日	271日	8日	361日	雄
9	同上	同上	五月廿三日	一月廿三日	二月十二日	同上	68日	245日	20日	[illegible]	[illegible]
10	同上	同上	五月六日	一月廿七日	二月三日	同上	51日	266日	7日	356日	雄
11	同上	同上	五月廿二日	一月廿五日	二月十一日	同上	67日	248日	17日	364日	[illegible]
12	同上	同上	五月六日	一月廿六日	二月四日	同上	51日	265日	9日	357日	雄

Studies on the Morphology, Habitat, and Life history of Saturnia pyretorum WestWood

Dhen Ying

— *Abstract* —

Saturnia pyretorum Westwood. being a species of Saturniidae, is known to occur in Kwangtung, Kwangsi, Fukien Kiangsi, Hunan, Hainan Island, and Formosa.

Eggs are somwhat rectangular, being 2.5 mm. in length, and 1.8 mm. In width. They are laid in masses on the branches of host plant.

A newly hatched larva measures 5.2 mm. in length, and 1mm. in width; while a full-grown one is 95 mm. in length, and 10.1 mm. in width. Some of the larvae melt four times; others five times, even if they come from the same eggmass. The mature larvae in search of proper places for pupation, come down to the lower part of the stem of host plant, or to the shrubs near it.

Pupation takes place within the cocoons. Pupae are elliptical. In average, they are 32.8 mm. in length, and 10.5mm. in width. The vissible segments on the dorsal side are ten in number, while on the ventral side they are six in number.

The male and the female moths can be distinguished easily. Their important differences are as follows:

1. The length of the male moth becomes enlarged toward the posterior end.
2. The abdomen of the female moth becomes pointed toward posterior end; that of the female moth becomes enlarged toward the posterior end.
3. The antennae of the male moth are plumose and broader than that of the female moth; those of the female moth are also plumose, but narrower than that of the male moth.

Annually *Saturnia pyretorum* has only one generation. Its life history may be briefly stated as follows:

Egg stage	Larval staga	Pupal stage	Abult stage
Mid-February to mid-Marbh.	Mid-March to early May.	Early May to lat Jan. (next year).	Late January to early February.

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2010.1.21
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